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Art. I.—*On the Occurrence of the Anchoring Tubes of Adeona in the Older Tertiaries of Victoria with an Account of their Structure.*

(Plate I.).

By T. S. Hall, M.A.,

Demonstrator and Assistant Lecturer in Biology in the University of Melbourne.

[Read 12th March, 1896.]

In the residue obtained from washing samples of the older Tertiary marine clays of various parts of Victoria, there occur numerous small cylindrical calcareous bodies, the nature of which has long been a puzzle to those who have examined them. Recently, while examining some specimens of *Adeona* in the collection of the late Dr. MacGillivray, in which the anchoring tubes were well preserved, the resemblance of the joints of the anchoring tubes of the polyzoon to the objects in question struck me very forcibly, and a dried specimen in the collection of the Biological School afforded sufficient material for making a careful comparison with the fossil forms.

The fossils are very variable in size and shape, but speaking generally they are cylindrical objects ranging up to about 3 mm. or 4 mm. in diameter and to about 5 mm. in length. The two terminal plane faces of the cylinder are generally perpendicular to its long axis, and are pierced by a number of fine pores, which are apparent without the aid of a lens. The lateral wall of the cylinder is formed by closely applied threadlike cords which branch and anastomose, leaving narrow elongated pores between them, the long axis of the pores coinciding in direction with that of the cylinder. Usually the diameter of the cylinder slightly increases somewhat suddenly at each end. In many cases the joints are branched, three branches sometimes meeting at one point. The proportion of the length of the cylinder to its diameter varies greatly in different specimens. Some are very elongate, while others are flat discs, all grades between the two extremes being found.

A transverse section shows a cylindrical canal occupying the organic centre and a series of canals, which are somewhat reniform in transverse section, arranged round this in several concentric circles. The canals are connected with those on the same radius by very fine tubules, connection of one canal with another beside it occurring rarely in the sections I have examined. The whole structure has therefore very much the appearance of an Haversian system of a mammalian bone, but the central canal is smaller and the fine tubules corresponding to the canaliculi are far fewer and coarser than in bone.

In longitudinal section the canals are seen as parallel tubes, and the connecting tubules, which are far apart, run, as a rule, somewhat obliquely from one canal to another. In one instance a "tabula" crossing a large canal was clearly seen.

A longitudinal section through the point where branching takes place shows that the central canal itself divides into two, a division running up the axial line of each branch. The fine tubules occasionally pierce the outer wall of the cylinder and their openings form the slitlike pores before mentioned. Some of the specimens of which I have made sections are infiltrated with iron pyrites, which has filled even the fine tubules, and the structure is thus more clearly shown than in those specimens where no infiltration has taken place.

In the recent condition the members of the genus, as restricted by MacGillivray, are fixed to foreign bodies by a flexible organ of attachment, which is built up of alternate calcareous and chitinous portions resembling, as Lamouroux remarks, the stem of *Isis*. The rooting apparatus is very variable in form and in the amount which is in contact with the usually pointed stalk (*stiel* of Kirchenpauer). Near its origin the calcareous portions are disc-like, but towards its distal portion become more elongate, and the rooting organ breaks up into cylindrical jointed twigs which branch copiously and frequently anastomose. Branching always takes place from the calcareous segments. The latter vary very much in length. The ultimate ramifications consist of a single hairlike tube which becomes firmly attached to a foreign body such as a rock or fragment of a molluscan shell, and in which the alternations of calcareous and chitinous segments is clearly visible, and in which branching and anastomosis also occur.

An examination of incinerated fragments and of a number of sections of the anchoring tubes of a dried, recent specimen shows that their structure is identical with that just described in the fossil. Each branch of the "root," in short, is a bundle of tubes arranged in several concentric circles. In the calcareous segments these tubes communicate with one another by fine connecting tubules, which do not apparently occur in the chitinous segments, where the tubes remain distinct and separate from one another.

The chitinous tubes are continued as a lining for a variable distance into the canals of the calcarous segments, and occasionally chitin may be traced into the connecting tubules. Judging by Kirchenpauer's description and figure he appears to have not noticed the larger canals in the calcareous segments, but to have seen the smaller ones only.* The structure of the rooting organ would be then, as he remarks, entirely different from that of any other genus of Cheilostomata, as in all other instances it consists of a chitinous tube more or less encrusted with calcareous matter. It will, however, be seen that the differences are not as great as he thought, though the alternation of calcareous and chitinous joints still marks it off strongly from the attaching structure of all other polyzoa.

Nicholson† figures the central portion of a transverse section of the zoarium of a recent *Cellepora* which shows practically the same structure as is seen in the rooting "organ" of Adeona. Sections which I have made of *Cellepora incrassata* from the Kara sea show that towards the centre of the older portion of a branch the zoœcia have assumed an elongate tube-like form, and the communication tubes have the appearance described by Nicholson. In the younger parts of a branch, that is towards its distal end, the structure is very like that shown in Nicholson's fig. 452, C. The modifications of the skeleton have their parallel in those of the zooids which build up its different parts, and the polymorphic character of the polyzoon colony has long been recognised.

The genus *Adeona* is restricted to the southern seas, several species having been recorded from Australia and South Africa.

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* Ueber die Bryozoen-Gattung Adeona.

† Manual of Palæontology, Nicholson and Lydekker, 3rd ed., vol. i., p. 607.

In our own seas it is rather a rare form, and is usually, I believe, dredged from a depth of about twenty fathoms.

It is noted as a common characteristic genus in our older Tertiaries by Dr. MacGillivray in his "Monograph of the Victorian Tertiary Polyzoa."

In common with several other geologists I regard the beds from which Dr. MacGillivray's Tertiary Polyzoa came, and from which I obtained these specimens, as of Eocene age.

The localities at which I have found examples are Mornington; Mouth of Duck Ponds Creek, Corio Bay (bore); Campbell's Point; Belmont (well sinking); Birregurra; Southern Moorabool Valley; Shelford; Muddy Creek.

EXPLANATION OF PLATE.

The Figures are all drawn from Fossil Specimens.

Figs. 1, 2, 3, 4.—Calcareous joints of Anchoring Tubes of *Adeona*. Enlarged.

Fig. 5.—Portion of external surface of same, showing corded nature of the surface and openings of pores.

Fig. 6.—Transverse section of same, infiltrated with pyrites. × 22.

Fig. 7.—Portion of 6 more highly magnified.

Fig. 8.—Longitudinal section showing bifurcation of central canal at point where branch is given off. × 22.

(Figs. 6, 7, 8, drawn under the camera lucida).

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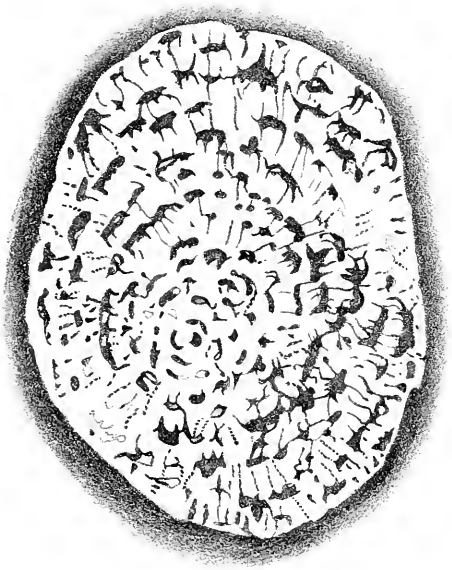

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Art. II.—*Description of two New Species of Marsupials from Central Australia.*

(With Plate II.)

By Baldwin Spencer, M.A., C.M.Z.S.,

Professor of Biology in the University of Melbourne.

[Read 12th March, 1896].

In the Report on the Mammalia of the Horn Expedition to Central Australia the following was appended as a foot-note to the list of mammals therein enumerated. "In addition to those named in this list, there certainly exist in Central Australia a species of Dasyurus and at least one of Perameles. Mr. Gillen informs me that at Alice Springs the blacks have a special corroboree associated with the 'Chilperta' or native cat. *Perameles fasciatus* is included in Sanger's list, and Mr. Byrne of Charlotte Waters, who is well acquainted with the Marsupial fauna of that district, tells me that he knows of the existence of one species of Perameles and believes that a species of Peragale occurs of considerably smaller size than and distinct from *P. lagotis*."

Since this was written I have received through the kindness of Mr. Gillen of Alice Springs and Mr. Byrne of Charlotte Waters four species of Marsupials, which more than corroborate the statement referred to.

From Alice Springs specimens of *Perameles obesula* and of *Dasyurus geoffroyi* have come. An incomplete skin of what is presumably the same species as the latter has also been secured by Mr. Bryne from Crown Point on the Finke River, so that evidently the species has a wide range in the centre.

The occurrence of *Perameles obesula* is of interest as it serves to considerably extend its distribution, which now stretches right across the whole of West and South Australia, Victoria, New South Wales, probably Southern Queensland and southwards to Tasmania. It is also of interest as being one of the very few species of animals belonging to any group which is possessed in common by Central Australia and Tasmania. The native name of the animal which has so far only been obtained in the Burt

Plains to the north of Alice Springs is "quirra:" Mr. Besley of Alice Springs states that it is plentiful in the neighbourhood of Tennant's Creek, which lies well within the tropics.

In addition to these two forms I have received from Messrs. Gillen and Byrne specimens of a new species of Perameles, and from Mr. Bryne specimen of a new species of Peragale, and I have once more to thank these gentlemen for their continued exertions, which have resulted in adding considerably, now as on previous occasions, to our knowledge of the Central Australian fauna.

The following is a description of the two new species:—

(1) Peragale minor. (Figs. 1, 2, 3, 4).

Size considerably smaller than *P. lagotis*. Fur very long, soft and silky; composed almost entirely of under-fur. General colour fawn-grey but darker than in *P. lagotis*.

Head long, muzzle narrow. Rhinarium naked at the tip of the snout but no backward prolongation of the naked part as in *P. lagotis*.

Face grey-brown, the under-fur on the face grey basally, then fawn coloured with a dark tip, the longer hairs with a longer black tip.

On the dorsal surface and sides of the body the under-fur is black basally, then fawn coloured. The longer hairs very little longer than the under-fur, with a black tip. The hairs of the under-fur very often have a dark brown tip.

Chin and inner side of fore-limbs white, the rest of the limbs and under surface grey, the fur with a dark grey basal part and white distal half.

Hands white. Hind feet white above, hairy beneath, the hairs on the posterior two-thirds black, the anterior third white.

Tail with the proximal two-thirds short haired. Along the dorsal line is a sharply marked narrow band of dark hair increasing in length distally. At one-third of the length from the posterior end the black hairs stop abruptly and are succeeded by a dorsal series of white hairs forming a distinct crest, the hairs of which are proportionately shorter than in *P. lagotis*. Sides and under surface of tail with scanty stiff white hairs.

Two small round pads at the base of the fourth and fifth toes.

A few long whisker-like hairs on the posterior side of the fore-limb, just above the wrist, the longest measuring about 40 mm.

Mammæ, 8. Two or three young ones apparently produced at one time.

DIMENSIONS.

	(*a*) Adult ♀ in al.	(*b*) Adult ♀ in al.	(*c*) Adult ♂ in al.	(*d*) Adult ♀ in al.	(*e*) Adult ♂ in al.
Head and Body -	215	200	245	240	270
Tail - - -	124	118	127	152	160
Hind Leg - -	58·5	57	65	62	73
Ear - - -	71	68	87	85	92
Muzzle to Eye -	31·5	31	37	39	41

Specimen (*a*) has two young ones in the pouch. Specimen (*b*) has the hinder pair of mammæ very small. Specimen (*d*) has three young ones in the pouch. The posterior mamma on the right side is wanting. The anterior pair are small. The second pair has an embryo attached on each side. The third mamma on the right side is small, that on the left has an embryo attached. The fourth on the right side is not developed, and that on the left side is small.

Skull (Plate II., Figs. 1 and 2). Much smaller and more delicate than in *P. lagotis*. The upper anterior end of the Premaxillary only slightly directed forwards, not so strongly marked as in *P. lagotis*, and in consequence the tip of the muzzle seen from the side is not so markedly trifid as in *P. lagotis*. Nasals long and narrow, their greatest breadth going between $4\frac{1}{2}$ to $4\frac{3}{4}$ times into their length. Interorbital region flat and not conspicuously constricted:* relatively much broader than in *P. lagotis*. Lachrymals much as in *P. lagotis* with a distinct ridge marking off the facial from the orbital surface.

* In the specimen of which the dimensions are given the intertemporal breadth (11 mm.) is exactly the same as in a skull of *Peragale lagotis*, the basal length of which is 90 mm.

There is a deep concavity between the two limbs forming the anterior forked end of the malar; the part of the zygomatic process of the maxilla in contact with the lower limb of the fork is produced into a distinct bluntly rounded process (Fig. 2).

Paroccipital process inconspicuous, forming a smooth rounded downgrowth fitting on to but not projecting beyond the hinder wall of the swollen mastoid portion of the auditory bulla.

Bullæ, both alisphenoid and mastoid portions, relatively more inflated with their surfaces smoother than in *P. lagotis*.

Anterior palatine foramen extending nearly as far back as the canine. Posterior palatine foramina extending from p^3 to m^3; divided by a narrow long septum. Large but irregular vacuities behind.*

Teeth. I^3 separated from i^1 by a diastema of 1·5 mm. and from the canine by a diastema of 3 mm. Canine long and strong, its distance from p^1, 4·5 mm. Premolars as in *P. lagotis*. Molars differing from those of *P. lagotis* in not being rounded in section, their summit with cusps much like though not so prominent as those in Perameles and in this respect resembling those of *P. leucura*. *Lower* canine slightly longer than the premolars. P^1 slightly longer longitudinally than p^4, p^3 decidedly longer than either of them. Molars distinctly cuspidate.

Skull Dimensions (♂).

	Mm.
Basal length	66
Greatest breadth	34
Nasals length	32
Nasals greatest breadth	6·5
Intertemporal breadth	11
Palate length	41
Palate breadth outside m^3	17·5
Palate breadth inside m^3	10·5
Palatal foramen	7
Basi-cranial axis	20
Basi-facial axis	46
Facial index	230

*In the specimen figured there is a single vacuity on the right side only between the anterior and posterior foramina—see Fig. 2.

Teeth.	Distance from front of canine to back of m^4	28
,,	Horizontal length p^3	3
,,	Horizontal length p^4	3
,,	Horizontal length ms^{1-3} ...	12

Type, in the National Museum, Melbourne.

There can I think be little doubt as to the specific distinction of the animal now described. Its smaller size, skull measurements and teeth distinguish it from *P. lagotis*, whilst its colour, skull measurements and the length of molars 1-3 (Fig. 4), serve to distinguish it from *P. leucura*. As yet we have not been able to meet with any further specimens of the latter species, though Mr. Byrne has spared no efforts to secure it.

With regard to the habits of the species now described Mr. Byrne writes, "whilst the 'Urgarta' (*P. lagotis*) occupies the inner end of his burrow the 'Urpila' (*P. minor*) during the winter months lies within a foot or so of the entrance of his and only uses the inner chamber during the summer. This peculiarity is taken advantage of by the natives who jump on the surface of the ground behind the 'Urpila' breaking it in and so cutting off his retreat to the inner chamber. He is thus compelled to rush out through the entrance where a native is waiting to give him his *quietus*. The 'Urgarta' (*P. lagotis*) cannot be captured in this way and has to be dug out. Both species are nocturnal in their habits."

Locality.—Sand-hills about forty miles to the north-east of Charlotte Waters.

(2) Perameles eremiana, sp. n. (Figs. 5, 6, 7).

Size medium; proportions slender. Fur soft with numerous long, dark, spiny hairs on the dorsal surface of the head and body; continued as two dark bands down either side of the rump. General colour of upper surface dull orange. Margin of upper jaw and under surface of head together with the whole under surface of the body white. An orange patch on the shoulders. A patch of dark grey under-fur on the outer side of the arm and fore-arm, the rest of the front limb being white. An orange patch on the rump between the two lines of long,

black, spiny hairs where the latter are absent. A patch of grey under-fur on the outer side of the hind-limb at the lower end of the hinder line of long black hairs. Inner side of hind-limb and upper surface of foot white.

Long hairs white at their base, the flattened out part and fine tip being black. Under-fur on the back grey basally with a white median part and an orange extremity. On the sides of the body the grey is wanting, and on the under surface, chin, etc., the orange is also absent.

Muzzle fairly long and slender.

Ears very long, narrow and pointed (Fig. 5), laid forward they reach 17 mm. beyond the anterior canthus of the eye, grey behind, with a brownish patch anteriorly. Metatragus about as broad as long with a rounded end.

A few long, white, whisker-like hairs just above the wrist; the longest measuring 58 mm.

Soles of the hind foot covered with dark brown hairs up to the pads at the base of the fourth or fifth toes.

Tail distinctly bicolour for its whole length. The upper surface with black (or very dark brown) spiny hairs sharply marked off from the white hairs on the under surface and side.

Mammæ, 8. Apparently two young produced at a time.

Dimensions.

	(*a*) Adult ♂ in al.	(*b*) Adult ♀ in al.
Head and Body - -	235	275
Tail - - -	118	135
Hind Foot - - -	50·2	55
Muzzle to Eye - -	37	38
Ear - - -	51	51

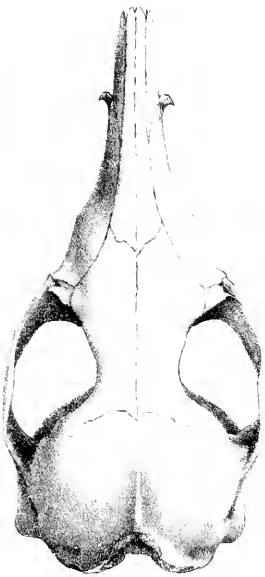

Fig. 1 × 1

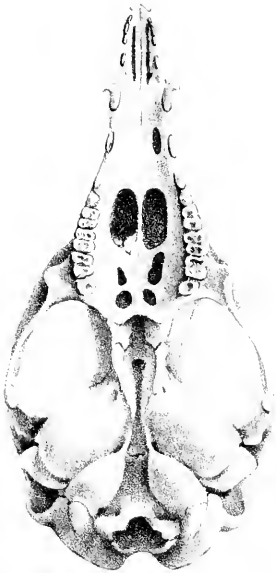

Fig. 2 × 1

Fig. 7 × 1

Fig. 4 × 3

Fig. 5 × 1

Fig. 6 × 1

Fig. 3 × 1

Skull Dimensions (♀).

	Mm.
Basal length	55·5
Greatest breadth	24
Nasals length	24
Nasals greatest width...	4·2
Intertemporal breadth	12·7
Palate length	3·6
Palate breadth between outer corners of m^3	14·5
Palate inside m^3	8·2
Palatal foramen	6·5
Basi-cranial axis	15
Basi-facial axis	41
Facial index	273·3
Teeth. Distance from point of canines to back of m^4	24
,, Length p^1	2·5
,, Length m^{1-3}	9·2

Type, in the National Museum, Melbourne.

The native name at Alice Springs is Mulgaruquirra, and at Charlotte Waters is Iwurra.

With regard to its habits Mr. Gillen says "the Mulgaruquirra scoops out a shallow hole on the surface of the ground just sufficiently large to lie in and thatches it with grass; habits nocturnal."

Mr. Byrne says:—"The Iwurra and Tubaija (*Chæropus castanotis*) are almost identical in their habits, and build similar nests of grass and twigs in shallow oval hollows scooped out in the ground. They are captured in the same way, viz., by placing one foot on the nest, pinning the animal down and then pulling him out with the hand."

Locality.—Burt Plain north of Alice Springs, and sand-hills about forty miles to the north-east of Charlotte Waters.

Art. III.—*Description of a New Genus of Terrestrial Isopoda, allied to the Genus Phreatoicus.*

(Plates III. and IV.)

By Prof. Baldwin Spencer, M.A., and T. S. Hall, M.A.

[Read 7th May, 1896.]

For the specimens upon which our work is based we are indebted to Mr. W. H. F. Hill, by whom they were obtained burrowing in earth on the hills overlooking the Gellibrand River, about twenty miles south of Colac in Victoria. The country is covered with dense forest, principally of Eucalyptus, and owing to its rugged nature has been but little explored zoologically.

In 1882 Dr. Charles Chilton* described a new genus of subterranean Isopoda to which he gave the name of *Phreatoicus*, obtained from wells in New Zealand; in 1891† he described another species of the same genus secured in water-holes on the summit of Mount Kosciusko, close to the boundary line between New South Wales and Victoria, and in 1894, in an important paper on "The Subterranean Crustacea of New Zealand,"‡ he gave further particulars with regard to the New Zealand species of the genus.

The genus now described is evidently closely related to though distinct from *Phreatoicus*, and we therefore propose the name of *Phreatoicopsis* for it. To facilitate comparison we have adhered as closely as possible to the method of description and nomenclature of Dr. Chilton.

Phreatoicopsis, n.g.

Body long, subcylindrical, laterally compressed. Upper antennæ short, lower long, with flagellum. Mandible with an appendage. First pair of legs subchelate, others simple. The legs are divided into an anterior series of four and a posterior series of three.

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* Trans. N.Z. Inst., vol. xv., p. 89.

† Records Aust. Mus., Sydney, vol. i., p. 149.

‡ Trans. Linn. Soc. London, May, 1894.

Pleon long, of six distinct segments, last joined to telson. Uropoda biramous, short and powerful. Telson large, sharply truncate.

Phreatoicopsis terricola, n.sp.

Specific diagnosis.—Body stout. Pleura of second, third, fourth and fifth segments of pleon moderately developed, being only as deep as their respective segments; their inferior margins fringed with a few small spinose setæ. Telson abruptly truncated. Lower antennæ about one-third of the length of the body: peduncle longer than flagellum; fourth and fifth joints of peduncle longest and equal in length. Legs long, slender. Lower lip with the adjacent edges of both lobes much hollowed out at the base, so as to leave a wide central space. Inner lobe of first maxilla narrow and with numerous plumose setæ at its extremity.

Colour.—Creamy white.

Length.—About 45 mm.

Habitat.—Banks of the Upper Gellibrand River, in burrows. (W. H. F. Hill).

Detailed Description.

The only specimens that we have hitherto received have all been males, so that the description of the points of difference shown by the female must be deferred for the present.

Body (Plate III., Fig. 1).—The length of the largest specimen we have is 48 mm. The body is broadest at the third and fourth segments of the pereion and then gradually decreases in width posteriorly. The depth of the body is somewhat less than its breadth in the pereion, but owing to lateral compression is slightly greater than its breadth in the pleon. The differences are, however, not very marked, though, owing to the great downward prolongation of the pleura, the compression appears more considerable than it really is. The dorsal surface of the pereion is very convex, the ventral being only slightly so. In the pleon the dorsal surface is more convex than in the pereion and the ventral surface is flat.

Head.—The head is very convex on the dorsal and anterior surfaces. The anterior end, as seen from above, is truncate. The anterior margin has a slight V-shaped cleft immediately below the level of the eyes. From the antero-inferior margin of the head a strong furrow runs upwards and then backwards, parallel to the long axis of the body, and reaches as far as the posterior end of the head. This furrow divides the head into two well-marked portions, the upper of which has the form of a quarter of a sphere, while the lower, as seen from the side, is oblong and forms a prominent convex cheek. The transverse depression mentioned by Chilton in *P. australis* and in *P. assimilis* is absent in the present species.

Eyes.—The eyes are as in *P. australis*, except that they consist of about forty lenses, in proportion with the greater size of the animal.

Pereion.—The first segment of the pereion is fused to the head, the line of union being strongly marked. The first segment is very little narrower than the second. The anterior and posterior dorsal edges are straight, and parallel to one another. In side view the segment widens slightly and is bent forwards in close apposition to the side of the head. The sides of the segment are globose and larger than in the case of the succeeding segments. The second, third and fourth segments are all of about equal size. The inferior margins (epimera) of each segment have a notch in the centre for the reception of the basi of the legs. The anterior angle is thickened and slightly produced downwards. In the fourth segment the posterior angle is formed by a slight flat fold, which gradually decreases in size in the preceding segments until, in the first, it forms merely a ridge which does not reach the posterior angle. The epimera of the fifth, sixth and seventh segments are broadly notched. The anterior margin of the fifth segment is produced forwards into a broad, rounded plate. The corresponding plates in the two succeeding segments are smaller and more angular in shape. The posterior marginal plates are of the same size in the three segments, that of the seventh segment being of about the same size as the anterior one.

Pleon.—The first segment is narrower than the seventh segment of the pereion, and gradually narrows as it passes downwards. It extends downwards considerably beyond the

epimera of the seventh segment and beyond the level of the joint between the basos and ischios of the seventh appendage. There is a tendency for the breadth of the segments to increase as they pass posteriorly, and this increase is most marked in the fifth segment. The pleura of the second, third, fourth and fifth segments are produced downwards further than those of the first and are about equal to their respective segments in depth.

The sixth segment and telson are coalesced, forming a tail-piece slightly concave below and convex above in both transverse and longitudinal section; the sides are flattened and the whole structure has a characteristic horse-shoe shape in transverse section. The posterior end is truncated and gapes widely. The margin of the posterior end is bordered by a series of strong, spinose setæ of varying length. The shape of this part of the body is markedly different from that of any of the three species of *Phreatoicus* yet described.

From the level of the upper and posterior angle of the insertion of the uropod a ridge, devoid of setæ, extends upwards and forwards for about half the height of the body, probably indicating the posterior limit of the sixth segment.

The inferior and posterior margins of the pleura of segments 1–5 bear a few short, spinose setæ, a sparse, narrow row of which is continued around the posterior margin of the segment.

The anterior inferior angle of the sixth segment is produced into a process, which bears a single strong spine.

The inner side of the basal part of the appendage is produced so as to form a process running along the inner side of the inner ramus, and bearing a few short spines.

Surface of Body.—The surface of the body is smooth, with only a very few short setæ scattered about irregularly. The whole surface of the body has a light cream colour in spirit specimens.

First Antennæ.—The first antennæ are short, reaching more than half way along the fourth joint of the second antennæ.

The *peduncle* consists of three joints, and is clearly distinguishable from the flagellum. The first joint of the peduncle projects freely beyond the head. It is broader than long and about the same length as the second. The third is shorter and narrower.

The *flagellum* consists of from ten to twelve joints. The second segment is the largest. The succeeding ones are about equal in

size to one another, excepting the last two which are smaller, the terminal one being the smallest.

Setæ are scattered sparsely on the surface of the peduncle. A row of setæ (? auditory cilia) passes round the distal end of each flagellum joint. There are a few setæ on the tip of the terminal joint.

Second Antennæ.—The *peduncle* consists of five joints and is about one fourth longer than the flagellum. The first joint is much the shortest; the second and third are equal in length and short; the fourth and fifth are longest and are equal in length. The third joint is rounded on the ventro-internal aspect. A few setæ are scattered sparsely and irregularly over the segments of the peduncle, with a row round the distal end of the fourth and fifth.

The *flagellum* consists of 23–27 joints. Of these, the first is much the longest, the next two or three are very slightly shorter than the rest, which are sub-equal, and gradually become narrower towards the distal end, where they increase in length. There is an interrupted row of setæ around the distal end of each joint.

Upper Lip.—The upper lip is large and strong and is regularly rounded at its distal end. It is divided into two portions. The proximal has a median and two lateral elevations. The distal part has a median depression and a raised rim. A strong transverse ridge separates the distal from the proximal part. The distal part is bent inwards to the mouth. There are a large number of close-set setæ on the inner surface which slant towards the median line.

Mandible.—The mandible has the same general shape as in *P. australis*, and the left one differs slightly from the right.

The *left mandible* (Plate IV., Fig. 2) has a cutting edge formed by two processes, both of which bear three strong, brown teeth. Within these is a short process with a truncate end, the somewhat circular margin of which is bordered by a row of spiniform setæ about twenty in number. There are no setæ between the base of this process and that of the molar tubercle, such as occur in *P. australis*. The molar tubercle is columnar in shape, with a squarely truncate end covered by a well-developed, chitinous cap, which is slightly concave. The concavity is

crossed by numerous ridges running parallel to one another and transversely to the length of the mandible. Each ridge is divided into a series of minute tubercles by transverse lines.

The *right mandible* (Fig. 3) has a cutting edge unlike that of *P. australis* and consists of two processes, the outer with four, the inner with two projecting points, which are, however, not so strongly chitinized as the corresponding structures of the left mandible. The next process is somewhat narrower than that of the left mandible, and its distal margin is crowned with a circle of spiniform setæ. The molar tubercle is longer and more slender than the left one, the distal end is more obliquely truncate, and the grinding surface, in minute structure, resembles that of the left. The inner of the two cutting processes is united proximally with the base of the setiferous process, and these two are capable of slight movement on the basal portion of the appendage.

The *palp* is three-jointed. The proximal part is the shortest; the median is the longest and bears setæ which are especially long at the distal end. The third joint bears three long setæ at its extremity.

Lower Lip (Fig. 4).—The lower lip consists of two fleshy lobes united proximally. The distal end of each is rounded and densely fringed with short setæ which curve in towards the middle line. These setæ are carried on a series of processes of the lobes and are thus collected into little brush-like groups.

The median part, connecting the bases of the two free lobes, is produced into the buccal cavity in the form of a grooved fold fringed by setæ.

First Maxilla (Figs. 5, 5*a*).—Consists of two divisions, of which the outer is the larger. It bends over somewhat towards the middle line and its end is truncate and carries about twenty-five strong brown chitinous teeth. The four outer ones are the largest and are separated from the remainder, which are arranged in three rows. The inner and the outer edges bear hair-like setæ.

The inner division is much smaller than the outer and forms a narrow flattened plate pointed at its distal extremity, where there is placed a group of setæ, more numerous than those in *P. australis*, and arranged in two series, an outer row formed of stout, strong setæ not more than one-third of the length of the others and doubly pectinate at their distal ends, and an inner group of long, strong, finely plumose setæ.

Second Maxilla (Fig. 6).—The basal part is produced at its inner distal end into a rounded, elongate lobe. External to this are two processes articulated to the basal joint. The inner margin differs in form from that of *P. australis*, and its outline is represented in the figure.

The end of the inner process carries a large number of setæ of two kinds: first long, plain setæ with curved, almost hooked extremities, and secondly, pectinate setæ. The inner margin has a fringe of long, plumose setæ. The whole surface bears sparsely scattered, large, pectinate setæ.

The *two articulating lobes* are slightly longer and much more slender than the inner lobe and are flattened from side to side. Each terminates in two stout, pectinate spines. The inner lobe also bears two simple spines. Both lobes carry a large number of pectinate setæ of varying length, which are more numerous on the inner than the outer process.

Maxillipedes (Fig. 7).—Coxos distinct and broader than long. The epipodite is relatively larger than in *P. australis*. The outer edge bears a fringe of very numerous short setæ. The basos is about half as long again as broad, but not so long relatively as in *P. australis*. From the inner side of the basos distally arises a flat plate, which reaches as far forward as the middle of the carpopodite. This plate, owing to the broadening of the carpo- and meropodite, cannot be seen from the outer side. The end of this plate is rounded and bears a number of strong, pectinate setæ, which are continued for some distance along the outer margin. The inner margin is fringed by a series of long, plumose setæ and at the basal part of the outer margin are three strong setæ, which are not hooked as they are in *P. australis*.

The ischios is short and rounded. The meros has its outer angle produced into a long process which runs upwards by the side of the carpus. The carpus is broadly subtriangular and very different in appearance from that of *P. australis*. The propodos is subtriangular, and the dactylos is roundly oblong. The whole appendage is strongly setose.

First pereiopod. The basos and ischios are much as in *P. australis*. The meros is subtriangular, the anterior side being produced into a long, strong process, which terminates in a single spiniform seta. The face turned towards the propodite is

flattened and expanded transversely, so as to form a surface against which rests the face of the propodite when the latter is bent back. The shape of the carpus is represented in the drawing. The propodite is much more swollen than in any of the three species hitherto described and is broadly triangular. The proximal half of the palm surface is produced so as to form a more or less flattened plate which terminates distally in a single stout tooth. Proximally to this the plate is bordered by a row of six short, stout spines, which lie slightly to the outer side, so that, when closed, the dactylos lies inside them. The dactylos is a long, powerful, curved structure, which can be closed down upon the palm of the propodite. At about half its length it bears a strongly-developed tooth, which fits into the space between the tooth on the propodite and the base of the dactylos.

Setæ are not so numerous as on the corresponding appendage of *P. australis*. The basos bears a few which are very short; the ischios carries a few tufts on its posterior side; the meros has very few; the carpus has well-developed tufts on its posterior side; a fringe of setæ lies to the outside of the spines on the posterior edge of the propodite, which also carries a narrow transverse band of setæ at the base of the dactylos on the anterior and posterior sides. The dactylos carries minute groups of little setæ, the groups being arranged in longitudinal rows.

Other Appendages of the Pereion.—The second, third and fourth appendages agree generally in form with those of *P. australis*, but the setæ are short, strong and spiney and very much less numerous. In the male there are no spines on the propodite similar to those of *P. australis*, and the dactytopodite is not bent round so as to form a claw, and has only a slight tooth developed. The fifth, sixth and seventh are similar to the fourth, the basos not being expanded as in *P. australis*.

First Pleopod (Fig. 8).—The endopodite is much stouter than the exopodite. At the inner proximal end a small lobe is indicated, and is indistinctly separated off from the main part, which terminates distally in a rounded end which is not emarginate as in *P. australis*.

The exopodite is long, narrow and pointed, with a slight curvature outwards and a lobe at its proximal end running alongside the basal portion. The margin of the exopodite is fringed with long simple setæ.

Second Pleopod.—The second pleopod is larger than the first pleopod. The endopodite consists of two parts. First the penial filament. This lies on the inner side and does not extend so far as the first joint of the exopodite. It curves slightly outwards and in transverse sections has the form of figure 8. A few short, stout setæ are present along the inner margin proximally.

The second portion is similar to the endopodite of the first pleopod except that the proximal lobe is not so well marked.

The exopodite consists of two joints. The proximal one has a process extending along the margin of the base and bears a fringe of simple setæ. The second joint is short and lanceolate. Its margin carries about forty-four simple setæ.

Third Pleopod.—The third pleopod has the endopodite similar in form to that of the first, except that the proximal lobe, though present, is not so large. The exopodite is similar to that of the second, except that the basal process is smaller. The protopodite gives off on the outer side a lobe which, according to Dr. Chilton, perhaps represents an epipodite, the margin of which is fringed with long, simple setæ.

The Fourth and Fifth Pleopods.—These are similar in general shape to the third, but the epipodite gradually increases in size from the third pleopod backwards.

Uropods.—The uropods do not project backwards beyond the pleon. The basal joint is as long as the longer of the two rami, and very stout. On its inner surface it bears, about half-way along its length, a strong spinose seta, and a few smaller setæ are present at intervals. Its distal extremity carries a single strong and one or two smaller spinose setæ, no pectinate ones being present in this position as in *P. australis.*

Its upper surface is broad and concave, and at the inner angle it is produced into a well-marked process terminating in a strong, spinose seta. A few large and small setæ are present along the upper inner margin.

The two rami are strong and curved : the inner is considerably longer than the outer, and both bear a few strong setæ which are not arranged in groups. The points of the rami are dark brown in colour.

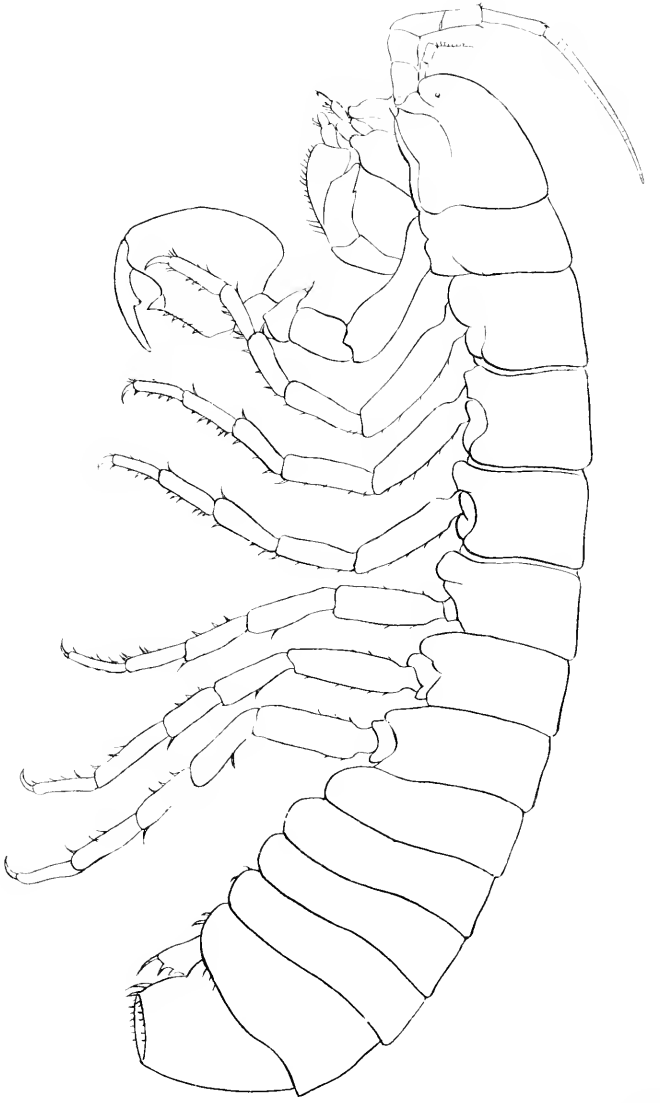

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Fig 2 × 8

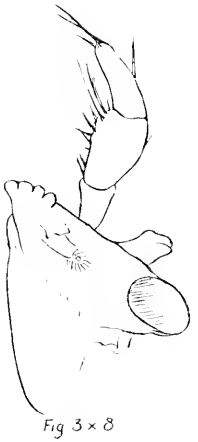

Fig 3 × 8

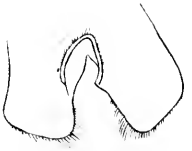

Fig 4 × 8.

Fig 5 × 8

Fig 5a × 8

Fig 6 × 8

Fig. 7 × 8

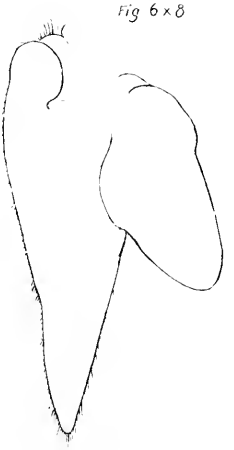

Fig. 8 × 8

T S H del

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Generic Position.—The present species differs from the members of the genus *Phreatoicus*, to which it is closely allied in two particulars, and to such an extent as to warrant the formation of a new genus for its reception. These are the form of the uropods and of the telson. In his generic description of *Phreatoicus*, Dr. Chilton characterises the telson as "subconical,"* and each of the species he describes has the telson terminated by a small, prominent projection of very characteristic form. This process is absent in our species and, though it is difficult by a single word to express the form of the telson, yet it certainly is not "subconical." Its sudden truncation and horse-shoe shape in transverse section are features which mark it off strongly from the form found in *Phreatoicus*. The uropods again are short and stout and do not project appreciably behind the telson, differing greatly in this respect from the long, styliform uropods of *Phreatoicus*.

A sexual difference found in the males of *Phreatoicus* again is not found in the present species. As described by Dr. Chilton the fourth pereiopod of the male is modified slightly so as to form a grasping organ of the subchelate type; whereas in our species this modification does not occur and the appendage is similar to the others.

EXPLANATION OF PLATES III. AND IV.

Fig. 1.—Phreatoicopsis terricola. ♂
Fig. 2.—Left Mandible.
Fig. 3.—Right Mandible.
Fig. 4.—Lower Lip.
Figs. 5, 5*a*.—First Maxilla.
Fig. 6.—Second Maxilla.
Fig. 7.—Maxillipede.
Fig. 8.—First Pleopod.

The magnification is indicated in the case of each figure.

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* Trans. New Zealand Institute, 1882, vol. xv., p. 89. Records of the Australian Museum, vol. i., p. 151. Trans. Linn. Soc. London, vol. vi., pt. 2, p. 185.

Art. IV.—*Geological Notes on the Gehi and Indi Rivers and Monaro Gap, Mount Kosciusko, N.S.W.*

By A. E. Kitson.

[Read 7th May, 1896.]

The portion of New South Wales referred to in this paper is comparatively little known, and therefore it may be advisable to make a few remarks on its topography before entering upon its geological features. By reference to the map submitted, which with certain alterations and additions is a copy of that published in 1881 by the Department of Lands and Survey of this Colony, it will be noticed that opposite the Bringeinbrong homestead the main stream receives a large tributary called the Little Murray, Swamp or Gehi River. From here to its source it is known as the Indi and on the east for some distance is flanked by the Youngal Range which runs to Mount Kosciusko and forms the divide between it and the Gehi; on the west by a range running to Mount Pinnibar in Victoria. On the east of the Gehi are many subsidiary spurs of the Dargal and Bogong Mountains, from which among others come its affluents, the Swampy Plain, Khancoban, Black and Gehi Creeks. Near its junction the river flows through the rich grassy flats of the Bringeinbrong and Khancoban Runs, but about ten miles higher up the valley rapidly narrows and the stream is more or less confined between steep gorges. The country between here and Groggin on the Indi, some thirty miles away, is uninhabited, but huts at Black Creek and Gehi River are used by drovers and travellers generally. Groggin has three inhabitants, the stockman of the run and two selectors on the Victorian side. From here the Kosciusko track crosses the Snowy and Leatherbarrel Creeks and their divides, which are spurs from the main peak, and branches off north at Monaro Gap, six miles from Mount Kosciusko, at an altitude of 5900 feet.

On the geological map of New South Wales, published in 1893, most of the country bordering on the Gehi and Indi Rivers is coloured as Silurian with a little granite some distance to the

east. As far as I have been able to discover, however, the geological features of the greater portion of the district have not yet been described. In his "Southern Gold Fields," p. 125, the late Rev. W. B. Clarke, M.A., F.G.S., etc., briefly speaks of the country between the Indi and the Muniong Range as granite and slate with dykes of porphyry from the subjacent granite, and near the summit the slate transmuted into an imperfect gneiss. The map published with the volume does not delineate the features of the country on the west of the Muniong Range and as the names of localities have since been changed it is exceedingly difficult to trace his course, but judging by the description given on p. 121, he appears to have followed the Snowy Creek up to the point opposite Leatherbarrel ford which is probably identical with his Woolayian, then along the present track to Burramungee (Monaro Gap?). Tangaruccan, spoken of on p. 138, may be the place now known as Tom Groggin or more commonly Groggin, and Piaderra also somewhere in the same locality. As regards that portion along the Groggin track the boundaries shown on the geological map will require a little variation since, with the exception of one limited portion, the whole area consists of various kinds of granite. In the following paper I shall endeavour to give a brief outline of the general geological features on this and the Kosciusko track as gathered during a hurried journey along it. Time forbade a careful examination of any particular locality, so the observations were necessarily general and there are several portions, more especially near the "Gehi Wall," that are highly interesting and worth careful study.

The Victorian township of Towong on the Murray River lies at the northern termination of the Mount Elliot Range consisting of granite and mica schist with highly auriferous quartz veins and reefs. A flat about a mile and a half wide separates this range from those in New South Wales and is a rich alluvium several feet deep with a sub-stratum of sand and gravel containing pebbles of granite, slates, mica schists, quartz, quartzite, etc. For some eight miles the track follows the valley of the Little Murray, then turns to the east to cross a low range forming the Khancoban—Black Creek Divide. The rock is a fine-grained, pinkish-grey granite with much orthoclase and quartz, but little

mica. It is greatly decomposed, forming a cold, poor soil of little depth, mainly of siliceous fragments with numerous pieces of rose quartz. The Black Creek contains granitic detritus only and from this point a plateau rises gently over a light grey biotite granite, with well-defined bosses here and there, to the "Gehi Wall," where the igneous rocks give place to vertical grey, yellow, brown and olive-green phyllites, argillaceous schists and slates. Many of them are exceedingly fissile, while others break into irregular, ragged-edged pieces. The boundary is plainly marked by a much more vigorous growth of timber on the "Wall" than on the plateau. The rocks have an almost due north and south strike, and so steep is the descent into Bain Creek at the foot that in a distance of some 350 yards the height comes from 2225 feet to 1400 feet.

Between Bain and Gehi Creeks the track crosses the point of a small spur where the rocks are similar to those in the "Wall." No outcrop occurs on this point, but in the bed of the Gehi Creek at the foot of the spur a striking example of contact metamorphism may be noticed. The original slates having a S. 50° W. dip of 61° have been transmuted into white, black, brown and grey porcellanite, lydianite and jasper, while on the southern bank a mass of grey granite outcrops at the water's edge, showing clearly that the stream at this point flows along the line of junction. The granite extends to the bank of the Gehi River near, and evidently the spur between the river and creek is composed of the same rock. The pebbles in both streams consist of the rock already mentioned as well as mica-schist, slate and quartzite, with glittering sand of white, yellow and black mica. In the river are large boulders of the local granite. At the "Wall" the stream enters a precipitous cañon and from its source to here is known as the Gehi.

At none of the three river fords close by is there any evidence of sedimentary rocks *in situ*, yet as the pebbles in the river above the creek junction include many of metamorphosed sedimentary origin it is highly probable that an outcrop of those rocks occurs in the neighbourhood. There is a marked absence of fossils in the "Wall," but judging by the great inclination and lithological characteristics of the rocks they are probably Lower Silurian.

Between the last-mentioned spur and the southern ridge there is a deposit of alluvium, twenty-five feet deep, showing the remains of old river terraces. The southern ridge is granite, some of it consisting of light-pink orthoclase, and pearly muscovite in about equal proportions with milky quartz, other portions of an exceedingly fine-grained, red, gneissose variety mainly composed of mica, highly decomposed and having a foliated appearance much like that of a mica schist.

From the end of this ridge the river valley bears straight towards Mount Kosciusko, through extremely rugged country hitherto found impracticable for horses and the track trends southwards to the Indi Valley. On leaving the river it follows the course of a large creek for some distance. In the gravels on the flat are several prospecting shafts from three to five feet deep. Between here and Scrubby Creek lies a low, granite spur of the Youngal Range whose highest point is some 2300 feet. The granite is a fine-grained muscovite variety of shades of grey, pink and red, the former prevailing on the Gehi slope and the latter on that into Scrubby Creek, where the rock decomposes into a rich, red loam of considerable depth. Granite of the same character occurs on the opposite slope, beyond which it changes to a greyish-white with little muscovite forming a poor soil. This is the main Youngal Range and has here an altitude of 2700 feet. After getting into the valley of the Indi no outcrop is visible till the river is reached. Between this point and Groggin the rock *in situ* may be seen in the bed of the stream, and also at the junction of Omeo Creek and again at Selk Creek, where it forms a bar almost across the river. It is a pretty, grey granite showing little decomposition, and is totally different from any met with south of the Gehi. It is evidently an intrusive one of more recent age, and comes in from the south through Groggin. The bed of the river contains several kinds of schists, slates, sandstones and granites. At Groggin the rock is of a much darker colour owing to an increase in the quantity of biotite.

Here the track leaves the Indi Valley and bears off for the Monaro Gap. As far as the Snowy Creek there is no appreciable change in the rock, and the stream contains the same kinds of

pebbles as the Indi. In the bank, however, there is a small outcrop of gneissose granite, much decomposed and overlain by two or three feet of gravels.

For some two miles the track ascends very rapidly up the range between the Snowy and Leatherbarrel Creeks over an interesting area of granite. In many places it is an amorphous or micro-crystalline felspar with a few small crystals of biotite and a little quartz; in others it has very much the appearance of a foliated granite; and again it is a typical granite with large crystals of white orthoclase and muscovite, with masses of grey opaque quartz. The orthoclase changes into various shades of pink, red and grey, and with the disappearance of the muscovite the rock becomes a pretty porphyritic aplite. Running through the granite with a general north and south strike are many dykes from five to twenty-five feet wide, some of a dense, hard, dark rock resembling diorite, much jointed and breaking into small blocks, others of a rock something like diabase. About four miles from Groggin the sedimentary rocks again become visible. No outcrop can be seen at the junction but small loose pieces of a red, very micaceous granite, much decomposed, appear on the granite side of the boundary. Some fifty yards further on the first outcrop of the stratified rocks occurs. It is a slightly contorted, white slate so much altered, broken and decomposed as to make it difficult to get an accurate dip. This, however, appears to be 66° to E. From here to the ford at the Leatherbarrel, over a mile away, the rocks gradually merge into the softer and less indurated slates and schists. Several outcrops convey the impression that those which now are much jointed, disintegrated and crumbling to a white clay were once very fissile, argillaceous slates. The strike of all varies from N. to N.E. with a dip of 55° to 71° E. to S.E. This western ridge has a height varying from 3300 to 3800 feet.

On the point overlooking the ford the rocks are talcose and argillaceous schists. Much jointed, yellowish-grey phyllites with a dip of 85° to 87° to E.N.E. outcrop in the bed of the creek which has here an altitude of about 3300 feet. On the steep eastern slope, however, the rocks can be seen to much better advantage, and observations taken are more accurate than on the opposite ridge where the outcrops are small. Argillaceous

schists and slates principally olive-green in colour are the prevailing rocks. They have a dip varying from 57° to 73° N. 50° E. to E.N.E.

Some of the slates are so exceedingly fissile that a good hand specimen cannot be obtained. They are also much jointed and slightly contorted. The joints run in many directions at high angles. Near the top of the cutting is a band of deep reddish-brown talc-schist intercalated between the slates. It presents a rough pitted surface and stands out in a well-marked ridge, affording a striking contrast to the soft, brittle and fissile slates on each side.

Veins of quartz from mere threads to reefs several inches wide intersect the strata on both sides of the creek, and at one place on the eastern ridge a reef nine inches to two feet wide crosses the track. The quartz is of a milky, vitreous nature, cellular, and highly charged with a green mineral which lines the walls of the cavities in minute hair-like crystals. These veins run more or less in the same direction as the strike of the rocks. The pebbles in the stream consist of schists, slates, and the foliated granite of the Kosciusko region, with many large sub-angular pieces of the local rocks. The gravel and sand is one glistening mass of brownish-yellow mica relieved by fragments of parti-coloured slates. The Leatherbarrel rocks resemble those at the "Gehi Wall" in many respects and probably belong to the same beds.

The top of the eastern ridge just above the creek is about 4000 feet high. From here no outcrop was noticed, still the character of the rocks indicates a transition similar to that on the western ridge. About two-and-a-half miles from the creek a highly siliceous granite makes its appearance. The junction is masked, but probably is at the point where the ridge meets the main divide. The quartz predominates greatly over the felspar and the crystals of mica are few and small. Rose quartz is plentiful and litters the bed of a small watercourse.

Nearer the Monaro Gap a distinctly foliated structure is apparent, and the rock partakes of the character of a siliceous gneiss. The foliations are finely marked and close together, the intervening felspar being removed for some little distance from the edge, giving the rock an interesting fretted appearance. The

pocket lens reveals a few minute flakes of pearly muscovite among the felspar bands. Later on biotite takes the place of muscovite though the rock is otherwise similar. This laminated characteristic occurs also in the rose quartz, many pieces having a distinctly banded appearance and occurring in certain definite shapes apparently indicating jointing. The joint planes run almost at right angles to the planes of lamination. Another feature of the rose quartz is a peculiar flecking of colourless quartz in a milky matrix to both of which the rose colour seems to be imparted.

The fretted fragments of gneiss and rose quartz persist to near the Monaro Gap where a grey, gneissose granite, appears. It is composed of quartz, medium crystals of light flesh-coloured orthoclase which weathers quite white, and small crystals of biotite, and is the prevailing rock on this part of the main divide.

I desire to express my thanks to Mr. A. W. Howitt, F.G.S., for generously undertaking to microscopically examine several of the rocks noticed; to Mr. T. S. Hall, M.A., for his kindness in revising this paper and suggesting several alterations which I have gratefully adopted; and to Mr. C. A. Robinson, for kindly preparing an enlargement of the maps before mentioned.

With the permission of the Society I hope at a future time to submit a few notes on the Geology of the country between Monaro Gap and Mount Kosciusko.

NOTE.—The distances and heights (aneroid) are to be taken as approximate only.

Art. V.—*Note on Aboriginal Rock Painting in the Victoria Range, County of Dundas, Victoria.*

(With Plate V.)

By Rev. John Mathew, M.A., B.D.

[Read 4th June, 1896.]

The Victoria Range, in the County of Dundas, Victoria, is remarkable for the multitude of bold, bare crags which crown its peaks and dot its sides. Some of them are gigantic in size and fantastic in form. On the face of one of these huge masses the sketches are to be seen which form the subject of this note. It is situated in the Parish of Billiminah about five miles east of Mr. Carter's Glenisla homestead, which is on the main road about half-way between Horsham and Hamilton.

On the north bank of the Billiminah Creek, at the point where it emerges from the bosom of the ranges and some three hundred yards from its bed, the rock stands, an impressive object, on the southern slope of a western rib of the Victoria Range. It rises abruptly to a height of upwards of sixty-five feet. The outline of the base is an oblong; the angles at the south end are approximately right angles, and the north end is rounded. Half-way up the rock on the northern side there is a large, natural cavern extending into the cliff some ten feet, the interior being visible from the ground.

The southern face of the rock is about fifty feet in width and projects over a plat of ground which has been cleared and levelled partly by nature, partly by human agency. The angle at the base is about sixty deg., but as the rock rises it declines more from the perpendicular. As the horizontal line taken from the middle of the base forward to the point whence a perpendicular would reach the brow of the rock measures forty-nine feet, the height of the brow from the ground must be at least sixty feet, and is probably more. The face fronts a little to east of south, widening and taking a slight turn to eastward near the summit.

The ground sheltered by the overhanging crag is marked by a curved line where herbage begins. From the centre of the face to this line the distance is thirty-three feet. This grassless, sheltered space is now a camp for sheep and cattle. At one time it must have formed a favourite resort of the blacks. Its former occupants have taken considerable trouble to clear away loose fragments of rock. There is also some indication of loose soil having been banked up at the southern edge of the protected part, suggesting that a breakwind may have been erected there. Looking southerly the view is charming. From the opposite side of the Billiminah Creek the Victoria Range extends to the south south-west as far as the eye can reach in a serrated line of rocky hills lightly clad with timber. In the immediate neighbourhood of the huge rock-shelter the hills are also wooded, the prevailing timber being stringy-bark. The delightful murmur of a waterfall comes from a short distance up-stream, and is audible at the rock.

At the base the cliff is a quartzose sandstone, of a greyish colour, translucent in places. Upwards the stone becomes redder and looser grained, and the striations are more distinct. Apart from a few cracks and easy undulations the surface on the south side is even and comparatively smooth, thus offering an enticing "canvas" to any one of artistic inclination.

As the highest markings are eight feet five inches from the ground in perpendicular height, it is evident that certain loose fragments of rock which lie outside the sheltered patch were lying at the base of the face and served as scaffolding to the artist when the paintings were executed, and were subsequently removed to render the place a comfortable camp. The lowest marks occur four inches from the ground. I take this as an indication that, since the completion of the work, a quantity of gravel has been gradually deposited under the shelter, having been conveyed from the east side by heavy downpours of rain and the trampling of animals.

The surface upon which the painting has been done measures from side to side thirty-seven feet. The work consists chiefly of numerous short upright strokes, a few slightly undulating lines drawn perpendicularly or horizontally, branches, foliage, and figures of animals. To get a fairly accurate reproduction is a

matter of considerable difficulty and necessitates very close and careful inspection for several reasons. The outlines are weather-worn and in various places it is next to impossible to distinguish them from the red blotches naturally in the stone. The difficulty of copying has been increased through the ambition of white people to secure a cheap fame by scribbling over the aboriginal work with charcoal. One feels indignant that so rare a relic of aboriginal art should be wantonly desecrated and defaced.

The paintings were discovered in 1866 by Messrs. Muirhead and Carter. The latter affirms that they look just about as fresh as when first seen. This is not surprising, as they are perfectly protected from rain. The oldest blacks professed to have seen them in their boyhood, but were so unfamiliar with the spot that they could not find it in spite of a day's deliberate searching. The authorship and date of execution were alike unknown to them.

An exceptionally intelligent black suggested that the strokes were a record of time during which encampments had been continued at the place. From their being visible upon some of the larger figures they are obviously, in part at least, a later addition to the picture. I have not delineated all the short strokes. Those I have given show how thickly they are distributed and their relative lengths and positions. It appeared to me that some of them were intended to represent grass and foliage.

The natives who inhabited the locality were called by themselves Kuli. They were of the same stock as the Victorian blacks generally, and formed part of the advance guard of the Wiraidheri, who inhabited the centre and south of New South Wales; the language of the Kuli, however, was marked by more numerous and distinct traces of relationship with the extinct Tasmanian race.

The principal subjects delineated are as follow:—

1. Seven men engaged in a corroboree.
2. An incomplete oval with a small figure like the conventional heart.
3. A man and woman, the man's left hand holding the woman's right.
4. Indistinguishable.

5. A wild turkey.
6. Man and woman, like No. 3.
7. Man climbing a tree.
8. An emu.
9. A native dog.
10. A man in the act of throwing a boomerang, the weapon remarkable as having an almost rectangular bend.
11. What seems to be a human hand. On the rock it has the appearance of having been impressed by the hand daubed with pigment.
12. Indistinguishable.
13. A man probably dancing in a corroboree. He wears a kangaroo tail and appears to hold weapons in his hands.
14. A man and woman like Nos. 3 and 6, but much better done.
15. Figure of a man, much worn away.
16. Kangaroo hunt: two men and two kangaroos; one of the men launching a boomerang, rectangular like that in No. 10.
17. Woman carrying child on her back.
18. Three figures, much worn, two of them female.
19. Two like figures, each holding a club in the right hand.
20. Seems meant for an iguana.

At the south-west corner I found small water-worn fragments of a loose-grained dark-red sandstone, which, when used as a chalk, marked the rock with exactly the same colour as the aboriginal scoring, but with a more sharply defined outline.

Rubbing the finger along this streak produced the same appearance as the drawing on the face which had been thus softened and dimmed by the weather. The figures in the painting are mostly of a darker tint than the strokes, and seem to have been made by smearing. Mr. Carter informed me that the natives used to gather a fine red dust, worn from the surface of rocks in the neighbourhood by the action of the weather. Mixing this powder with opossum fat they formed a paste which, when dried, they used as raddle for marking. No doubt the figures of darker hue were done with this preparation.

On a smaller shelter, distant some 200 yards south-east from the large rock, a few marks are to be seen. These embrace a

Scale: one foot to an inch.

number of upright strokes, three short upright strokes within two short lines joined by the upper ends at a right angle, a bird's foot, and an oval figure possibly the outline of a human head, with a dot for the mouth and shading for a beard.

As compared with aboriginal paintings elsewhere, those at Billiminah are distinguished by the use of only one colour, and by having the bodies of the animal figures entirely filled in. They differ absolutely from those at the other Glenelg River in the north-west of Australia in subjects, treatment and colouring, but in the pose of the human figures in action, bear a strong resemblance to the aboriginal sketches in New South Wales which have been figured by Mr. R. H. Mathews and others.

Art. VI.—*On some Facts in the Geographical Distribution of Land and Fresh-water Vertebrates in Victoria.*

By A. H. S. Lucas, M.A., B.Sc.

[Read 8th July, 1896.]

A part of this paper was prepared for the Melbourne meeting of the Australasian Association for the Advancement of Science, 1890, and was read before the Biological Section. As, at that time, certain orders, the Lizards and Batrachians, had not been carefully studied, it seemed better to defer publication until the facts of distribution of these orders had been ascertained. I have since published in the Proceedings of this Society a Census of Victorian Batrachians (1891), and also, in conjunction with Mr. Frost, a Monograph of the Victorian Lizards (1893). I am accordingly now able to present a more complete account of the general features of the geographical distribution of Victorian Land and Fresh-water Vertebrates.

Limited as is its area, the colony of Victoria comprises in its territory a great variety of country. The grass plains of the north, the mallee scrub of the north-west, the rich undulating grazing country of the Western District, the Alps of the North-East, the moist forests of Gippsland, and the Southern District which surrounds Port Phillip, lying between the Otway Ranges and Wilson's Promontory, and comprising but slightly elevated country with moors and swamps and lightly timbered areas, constitute some half dozen well-marked natural divisions. For years Baron von Mueller has been indefatigable in collecting precise records of the occurrence of our native plants in all parts of the colony (as indeed of all parts of our continent), and in his "Key to the System of Victorian Plants" he has published a table of their distribution. The regions which he adopts as a result of his knowledge of the flora are the same as those

indicated, except that he combines in one the Mallee and the Murray Plains.

While Victoria thus possesses provinces which are sufficiently distinct from one another in their geographical and botanical features, these are in most instances physically continuous with adjacent regions of the neighbouring colonies. Thus the northern plains form but a part of the great Central Murray basin, the Mallee and Western District are only separated by an imaginary meridian from South Australia, and the Alpine and East Gippsland regions merge in the mountain and coast regions of New South Wales, and thus form an extension of the eastern strip of our continent.

We have no such complete and definite information as to the local distribution of animals as the Baron has secured of that of the plants. Animals, especially the higher forms, are more difficult to obtain and to preserve than plants. In this regard the need is felt of local museums in each of the provinces in which examples from as many localities as possible might be preserved and be available for the aid of students of distribution and variation. This is especially desirable in the case of the Vertebrates, which are so liable to compulsory migrations or local extinction on the advent of civilised man.

In this paper I have attempted, as far as is possible in the present state of our knowledge, to tabulate the distribution of Victorian Vertebrates, omitting birds, and to discuss the summarised facts. I have made use of all precise records in Gould, the British Museum catalogues, the Victorian National Museum, and Professor McCoy's "Prodromus of Victorian Zoology," and of a large number of private and personal collections. Mr. D. LeSouef gave me very valuable information on the distribution of the mammals. For purposes of comparison the distribution of Tasmanian forms is included as far as known with precision. In the Mammalian table, "T," in the first column, stands for Tasmania, the other columns giving the distribution in Victoria.

MAMMALIA.

CHIROPTERA.

	T.	S.	S.W.	N.W.	N.E.	E.
A. Frugivora.						
Pteropus.						
P. poliocephalus, Temm.				x		x
B. Insectivora.						
Nyctinomus.						
(= *Molossus* of Gray)						
N. australis, Gray		x				
N. plicatus, Buch.-Ham.	x					
Chalinolobus.						
C. tuberculatus, Forster	x	x				
C. gouldi, Gray	x	x				
Nyctophilus.						
N. timoriensis, Geoffroy	x	x				
Vesperugo.						
V. pumilus, Gray*	x					
V. kreffti, Peters	x					

The Victorian Bats have not been thoroughly collected or studied. Bats, too, as winged animals with considerable powers of flight would be capable of being carried with ease over such barriers as the Dividing Range or Bass's Straits. Wallace states that two small species of North American bats occasionally reach Bermuda, a distance of at least 700 miles. *Nyctinomus australis* occurs in New Guinea, *N. plicatus* in India, and *Nyctophilus timoriensis* all over Australia and in the Malay Archipelago. We cannot conclude much from our table then, except that we may probably consider that the conspicuous absence of Fruit Bats from Tasmanian orchards is due in parts to the lower temperatures of the southern island.

* Said to occur all over Australia.

RODENTIA.

	T.	S.	S.W.	N.W.	N.E.	E.
MURIDÆ.						
MUS.						
M. novæ-hollandiæ, Waterh.				x		
M. tetragonurus, Hig. & Pet.	x					
M. pachyurus, H. & P.	x					
M. castaneus, H. & P.	x					
M. tamarensis, H. & P.	x					
M. velutinus, Thomas	x					
M. setifer, Horsfield	x					
M. fuscipes, Waterh.	x					
M. grisco-coeruleus, H. & P.	x					
M. leucopus, H. & P.	x					
M. variabilis, H. & P.	x					
M. simsoni, H. & P.	x					
M. penicillatus, Gould	x					
HYDROMYS.						
H. chrysogaster, Geoff.	x	x		x		
MASTACOMYS.						
M. fuscus, Thomas	x					
HAPALOTIS.						
(= *Conilurus*, Og.)						
H. conditor, Gould				x		
H. mitchelli, Ogilby				x		
H. apicalis, Gould				x		
H. albipes, Licht.				x		

Here we are at once struck with the restriction of *Hapalotis* to the northern parts of Victoria. The moister climates of Southern and Eastern Victoria and of Tasmania are unfavourable to the genus. *Mastacomys* has been met with in Central Australia (Horn Expedition) and in the fossil state in New South Wales. *Hydromys* is widely spread over Australia. The species of *Mus* clearly need more attention. If the Tasmanian species enumerated all hold good, it would be a very remarkable thing if a large number of them should not also occur in Victoria. That the Victorian mice have been so far pretty much neglected must indeed be freely admitted.

CARNIVORA.

	T.	S.	S.W.	N.W.	N.E.	E.
CANIDÆ.						
CANIS.						
C. dingo, Blum.		x	x	x	x	x

I suppose there is but little doubt that the Dingo is a comparatively late arrival in Australia. The Bass Straits were very much as they are at present, and the Dingo had no means, or need, of crossing them. On the mainland his rivals, the Thylacine and the Tasmanian Devil, early became extinct before him. They have survived in Tasmania, though the progress of the white man threatens their extinction.

MARSUPIALIA.

DASYURIDÆ.

	T.	S.	S.W.	N.W.	N.E.	E.
PHASCOLOGALE.						
P. flavipes, Waterh. (var. *typica*, B.M.C.)		x		x		
P. calura, Gould				x		
P. penicillata, Shaw		x	x	x	x	x
P. swainsoni, Waterh.	x	x				
P. minima, Geoffr.	x					
SMINTHOPSIS.						
S. murina, Waterh.			x	x		
S. leucopus, Gray	x	x				
S. crassicaudata, Gould		x	x			
ANTECHINOMYS.						
A. lanigera, Gould				x		
DASYURUS.						
D. geoffroyi, Gould				x		
D. viverrinus, Shaw	x	x	x	x	x	x
D. maculatus, Shaw	x	x			x	
THYLACINUS.						
T. cynocephalus, Fischer	x					
SARCOPHILUS.						
S. ursinus, F. Cuv.	x					

Among the Dasyurids we may note the restriction of *Phascologale calura*, *Sminthopsis murina*, *Antechinomys laniger*a and *Dasyurus geoffroyi* to N.W. Victoria, and the restriction of *Phascologale minima*, *Thylacinus cynocephalus* and *Sarcophilus ursinus* to Tasmania; the former apparently due to the climatic (especially, as has been suggested by Professor Spencer, probably the hygrometric) barrier, and the latter to the absence of the dingo, while we have already alluded to the influence of the absence of the dingo on the perpetuation of the larger Tasmanian carnivorous marsupials in Tasmania. Further, while *Phascologale flavipes* and the more widely distributed *P. penicillata* occur in North and in South Victoria, *P. swainsoni* and *Sminthopsis leucopus* and *Dasyurus maculatus* are found in Tasmania and only the moister districts of Victoria.

PERAMELIDÆ.

	T.	S.	S.W.	N.W.	N.E.	E.
PERAMELES.						
P. obesula, Shaw	x	x				
P. nasuta, Geoff.		x				
P. gunnii, Gray	x	x	x	x		
P. bougainvilii, Quoy & Gaim. var. *fasciata*, Gray				x		
CHÆROPUS.						
C. castanotis, Gray				x		

Thus *Perameles fasciata* and *Chœropus castanotis* are confined to the less humid part of Victoria, where *P. obesula* is wanting, though it occurs in Tasmania and Southern Victoria.

PHALANGERIDÆ.

	T.	S.	S.W.	N.W.	N.E.	E.
PHASCOLARCTUS.						
P. cinereus, Goldfuss		X	X	X	X	X
PHALANGISTA.						
Trichosurus.						
T. vulpecula, Kerr		X	X	X	X	X
var. *fuliginosus*, Og.	X					
T. caninus, Ogilby					X	X
Pseudochirus.						
P. cooki, Desm.	X	X	X		X	X
P. peregrinus, Bodd.		X				
DROMICIA.						
D. lepida, Oldfield Thomas	X					
D. nana, Desm.	X	X				
PETAUROIDES.						
(= Petaurista, Desm.)						
P. taguanoides, Desm.						
(= *volans*, var. *typica*, Thomas)		X	X	X		
PETAURUS.						
(= *Belideus*)						
P. breviceps, Waterh.				X	X	X
P. australis, Shaw						X
P. sciureus, Shaw		X				
GYMNOBELIDEUS.						
G. leadbeateri, McCoy		X				
ACROBATES.						
A. pygmæus, Shaw		X				

PHASCOLOMYIDÆ.

	T.	S.	S.W.	N.W.	N.E.	E.
PHASCOLOMYS.						
P. ursinus, Shaw	X					
P. mitchelli, Owen		X	X	X		

Tasmania is distinctly weaker in *Phalangeridæ*. The absence of *Phascolarctus* is very marked. There are no peculiar North Victorian forms in these two families. This distribution agrees well with the nearly total absence of the forest-loving *Phalangeridæ* from Central Australia (Horn Expedition).

MACROPODIDÆ.

	T.	S.	S.W.	N.W.	N.E.	E.
MACROPUS.						
M. giganteus, Zimm.		x	x	x	x	x
var. *fuliginosus*, Desm.	x			x		
var. *melanops*, Gould				x		
M. robustus, Gould				x		
M. rufus, Desm.				x		
M. ualabatus, L. & G.						
typicus, Thomas		x				x
M. ruficollis, Desm.						
var. *typicus*, Thomas		x				
var. *bennettii*, Waterh.	x	x				x
M. thetidis, Less.						x
ONYCHOGALE.						
O. frenata, Gould				x		
O. lunata, Gould				x		
LAGORCHESTES.						
L. leporoides, Gould				x		
PETROGALE.						
P. penicillata, Gray		x				
BETTONGIA.						
B. cuniculus, Og.	x	x				
B. penicillata, Gray		x				
POTOROUS.						
P. tridactylus, Kerr						
= *P apicalis*, Gould	x					
= *P. rufus*, H. & P.		x				

The northern group of *Macropodidæ* is very marked, consisting of *M. rufus*, *M. robustus*, *Onychogale fraenata* and *O. lunata*, and *Lagorchestes leporoides*. The Tasmanian forms are few in number but are all closely allied to those of Southern Victoria.

MONOTREMATA.

	T.	S.	S.W.	N.W.	N.E.	E.
ECHIDNIDÆ.						
ECHIDNA.						
E. aculeata, Shaw		x	x	x	x	x
var. *setosa*, Cuv.	x					
ORNITHORHYNCHIDÆ.						
ORNITHORHYNCHUS.						
O. anatinus, Shaw	x	x			x	x

REPTILIA.

CHELONIA.

	T.	S. & E.	N. & W.
CHELYDIDÆ.			
EMYDURA (CHELYMYS).			
E. macquaria, Cuv.			x
CHELODINA.			
C. longicollis, Shaw		x	x

Neither of these Chelonians seems to have reached Tasmania. *Emydura macquaria* does not appear to be an inhabitant of Coastal New South Wales or South-East Victoria, while *Chelodina longicollis* occurs freely on both sides of the mountain chain in both colonies.

OPHIDIA.

	T.	S. & E.	N. & W.
TYPHLOPIDÆ.			
TYPHLOPS.			
T. bicolor, Peters		x	
T. polygrammicus, Schleg.			x
T. bi-tuberculatus, Peters			x
DENDROPHIDÆ.			
DENDROPHIS.			
D. punctulata, Gray			x
PYTHONIDÆ.			
MORELIA.			
M. variegata, Gray			x
M. spilotes			x
ELAPIDÆ.			
DIEMENIA.			
D. superciliosa, Fischer	?	x	x
D. microlepidota, McCoy			x
D. aspidorhyncha, McCoy			x
D. reticulata, Gray			x
PSEUDONAJA.			
P. nuchalis, Günth.			x
PSEUDECHIS.			
P. porphyriacus, Shaw		x	x
P. australis, Gray			x
FURINA.			
F. bicucullata, McCoy			x
HOPLOCEPHALUS.			
H. curtus, Schl.	x	x	x
H. superbus, Günth.	x	x	
H. flagellum, McCoy	x	x	
H. coronoides, Günther	x	x	
H. signatus, Jan.		x	
VERMICELLA.			
V. annulata, Gray			x
ACANTHOPHIS.			
A. antarctica, Shaw			x

In summaries of this sort, while we may make use of numbers, we are very far from being able to obtain in accurate numerical terms the relations which the compared regions bear to one another. The number of species which are common to two regions may be the same as that for two other regions, but, if the former are species abounding in individuals while the latter are rare forms, it is plain that the latter relationship points to a more ancient continuity than the former. Inaccuracy in report of single or infrequent occurrences may greatly affect numerical statistics. There is always a margin of doubtful cases which we cannot altogether exclude, and cannot put into the same category with well-authenticated or especially with well-known species. Numbers then can do little more than indicate the general trend of the evidence.

Of the harmless snakes there are no Tasmanian records, but in Victoria there are Blind Snakes, Green Tree Snakes and Carpet Snakes. Of the Blind Snakes *Typhlops polygrammicus* is common in the warm, drier, northern parts of the colony. Krefft mentions *T. bicolor* as being found near Melbourne, but it is certainly uncommon.

The Tree Snake, *Dendrophis punctulata*, is in Victoria confined to the northern area, where it is tolerably plentiful. The Carpet Snake, *Morelia variegata*, is not met with south of the Divide, but becomes common toward the Murray border. It occurs in all parts of Australia, except in South Victoria and the adjacent coast district of New South Wales. Krefft records the allied Diamond Snake of New South Wales, *M. spilotes*,* from the Murray district of Victoria.

Speaking generally then, the harmless snakes are characteristic of the northern, and are but rare visitors of the southern, parts of Victoria. Of the venomous snakes, *Furina*, *Vermicella* and *Acanthopsis* are northern genera exclusively.

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* *M. variegatus* and *M. spilotes* are united in the B.M. Catalogue.

LACERTILIA.

	T.	S. & E.	N. & W.
GECKONIDÆ.			
GYMNODACTYLUS.			
G. miliusii, Bory.			X
PHYLLODACTYLUS.			
P. marmoratus, Gray			X
DIPLODACTYLUS.			
D. strophurus, D. & B.			X
D. vittatus, Gray			X
D. tessellatus, Günth.			X
GEHYRA.			
G. variegata, D. & B.			X
PYGOPODIDÆ.			
PYGOPUS.			
P. lepidotus, Lac.	X	X	X
DELMA.			
D. fraseri, Gray		X	X
D. impar, Fischer		X	X
APRASIA.			
A. pulchella, Gray		X*	X*
LIALIS.			
L. burtonii, Gray			X
AGAMIDÆ.			
AMPHIBOLURUS.			
A. adelaidensis, Gray	X (var.)		X
A. pictus, Peters			X
A. angulifer, Gray	X	X	
A. muricatus, White	X	X	X
A. barbatus, Cuv.	X	X	X
TYMPANOCRYPTIS.			
T. lineata, Peters		X	X
PHYSIGNATHUS.			
P. lesueurii, Gray		X	
VARANIDÆ.			
VARANUS.			
V. varius, Shaw		X	X
V. gouldii, Gray			X
SCINCIDÆ.			
EGERNIA.			
E. whitii, Lacép.	X	X	X
E. striolata, Peters		X	X
E. cunninghami, Gray		X	X

* Portland.

	T.	S. & E.	N. & W.
TRACHYSAURUS.			
T. rugosus, Gray			x
TILIQUA.			
T. scincoides, White	x	x	x
T. nigro-lutea, Gray	x	x	x*
T. occipitalis, Peters			x
HINULIA (LYGOSOMA).			
H. lesueurii, D. & B.		x	x
H. taeniolata, White		x	
H. quoyi, D. & B.		x	x
LIOLEPISMA (LYGOSOMA)			
L. mustelinum, O'Sh.		x	
L. entrecasteauxii, D. & B.	x	x	
L. trilineatum, Gray	x	x	x
L. metallicum, O'Sh.	x	x	
L. guichenoti, D. & B.		x	x
L. pretiosum, O'Sh.	x	x	
L. ocellatum, Gray	x		
K. tetradactylum, O'Sh.			x
EMOA (LYGOSOMA)			
E. spenceri, L. & F.		x	
HOMOLEPIDA (LYGOSOMA)			
H. casuarinae, D. & B.	x		
HEMIERGIS (LYGOSOMA)			
H. peronii, Fitzing		x	
H. decresiensis, Gray		x	
SIAPHOS (LYGOSOMA).			
S. maccoyi, L. & F.		x	x†
RHODONA (LYGOSOMA).			
R. bougainvillii, Gray		x	x
R. punctato-vittata, Günth.			x
ABLEPHARUS.			
A. boutonii, Desjard.			x
A. lineo-ocellatus, D. & B.		x	x
A. greyi, Gray			x
A. rhodonoides, L. & F. (M.S.)			x

* Grampians. † Goulburn Valley.

The table discloses the interesting fact that the Geckos are apparently altogether absent from Tasmania, and the forests of south-east Victoria, while they abound in the drier interior. Other forms restricted to the north-west are *Lialis*, *Amphibolurus pictus*, *Varanus gouldii*, *Trachysaurus*, *Tiliqua occipitalis*, *Rhodona punctato-vittata*, and *Ablepharus boutonii*, and *A. greyi*. The Tasmanian Lizards are of much fewer species than the Victorian, but they are of South Victorian alliances, comprising a rather marked subsection of *Amphibolurus*, and a number of the skinks with a transparent disk in the lower eyelid. *Homolepida casuarinæ* probably occurs or has occurred in East Gippsland, as it is found in Coastal New South Wales.

AMPHIBIA.

	T.	S.	S.W.	N.W.	N.E.	E.
CYSTIGNATHIDÆ.						
LIMNODYNASTES.						
L. peronii, Günth.	x	x				
L. tasmaniensis, Günth.	x	x	x	x		
L. dorsalis, Gray		x				
CRINIA.						
C. signifera, Girard		x	x			
C. tasmaniensis, Günth.	x					
C. lævis, Günth.	x					
C. victoriana, Boulgr.		x				
C. froggatti, Fletcher		x	x	x		x
HELEIOPORUS.						
H. pictus, Peters		x		x		
BUFONIDÆ.						
PSEUDOPHRYNE.						
P. bibronii, Günth.		x	x	x		
P. semimarmorata, Lucas		x				
P. dendyi, Lucas					x	
HYLIDÆ.						
HYLA.						
H. aurea, Lesson	x	x				
H. peronii, Bibron	x			x		
H. parvidens, Peters		?				
H. ewingii, D. & B.	x	x	x			
H. lesueurii, D. & B.					x	

In the Census of Victorian Frogs, P.R.S.V., 1891, I included *Heleioporus albopunctatus*. This was an error. The specimens on which the inclusion was based proved to be very old and large individuals of *Limnodynastes dorsalis*.

I am inclined to suspect that all the smooth Crinias of Victoria and Tasmania are varieties of but one species.

There does not seem to be in Victoria the marked distinction between the interior and coast forms of Batrachians which Mr. Fletcher has pointed out in the New South Wales species. Certainly the drier conditions of inland New South Wales are much severer than those of inland Victoria. The frogs of Northern Victoria, too, it must be admitted are not sufficiently known.

The most striking fact brought out by the table is the absence of *Heleioporus* and *Pseudophryne* (as far as is known) from Tasmania.

PISCES.

	T.	S.V.	N.V.
PERCIDÆ.			
LATES.			
L. colonorum, Günth.	x	x	
L. similis, Castelnau		x	
L. antarcticus, Cast.		x	
L. victoriæ, Cast.		x	
MICROPERCA.			
M. tasmaniæ, Johnston	x		
M. yarræ, Cast.		x	
OLIGORUS.			
O. macquariensis, C. & V.			x
O. mitchelli, Cast.			x
CTENOLATES.			
C. auratus, Cast.			x
C. chrystyi, Cast.			x
PRISTIPOMATIDÆ.			
THERAPON.			
T. niger, Cast.			x
T. richardsoni, Cast.			x
MURRAYIA.			
M. guntheri, Cast.			x
M. cyprinoides, Cast.			x

	T.	SV..	N.V.
M. bramoides, Cast.			x
M. riverina, Krefft			x
RIVERINA.			
R. fluviatilis, Cast.			x
SPARIDÆ.			
GIRELLA.			
G. tricuspidata, C. & V.	x	x	
G. simplex, Richardson	x	x	
G. blackii, Cast.		x	
CHRYSOPHRYS.			
C. australis, Günth.	x	x	
TRACHINIDÆ.			
APHRITIS.			
A. urvillii, C. & V	x	?	
A. bassi, Cast.		x	
MUGILIDÆ.			
AGONOSTOMA.			
A. diemensis, Rich.	x	x	
A. lacustris, Cast.	x*	x	
GADOPSIDÆ.			
GADOPSIS.			
G. marmoratus, Rich.	x	x	x†
G. gibbosus, McCoy	Similar	x	
G. gracilis, McCoy	Varieties	x	
SILURIDÆ.			
COPIDOGLANIS.			
C. tandanus, Mitchell			x 3 Varieties
HAPLOCHITONIDÆ.			
PROTOTROCTES.			
P. marœna, Günth.	x	x	
GALAXIDÆ.			
GALAXIAS.			
G. truttaceus, C. & V.	x	x	
G. attenuatus, Jenyns	x	x	
G. ocellatus, McCoy		x	
G. auratus, Johnston	x		
G. cylindricus, Cast.		x	
G. delicatulus, Cast.		x	
G. weedoni, Johnst.	x		

* King Island. † Small in upper reaches.

	T.	S.V.	N.V.
G. atkinsoni, Johnst.	x		
G. amoenus, Cast.		x	
G. versicolor, Cast.		x	
G. ornatus, Cast.		x	
G. nigothoruk, Lucas		x	
CYPRINIDÆ.			
NEO-CARASSIUS.			
N. ventricosus, Cast.		x	
CLUPEIDÆ.			
CHATOESSUS.			
C. richardsoni, Cast.			x
MURÆNIDÆ.			
ANGUILLA.			
A. australis, Rich.	x	x	
A. reinhardtii, Cast.		x	
PETROMYZONTIDÆ.			
MORDACIA.			
M. mordax, Rich.	x	x	
GEOTRIA.			
G. allporti, Günth.	x		
G. australis, Gray		x	

Professor McCoy, in his "Prodromus of Victorian Zoology," long ago pointed out the remarkable distinctness between the fishes of the rivers which flow into the Bass Straits and those of the rivers of the Murray system.

The absence of *Gadopsis* from the northern rivers of Victoria may be due to the presence of *Oligorus*. Young individuals occur in the upper reaches in which *Oligorus* does not, and the introduction of the Murray Cod into the Yarra since 1857, has practically destroyed the Blackfish in that river.

The close correspondence of the South Victorian and Tasmanian genera, often species, will be obvious from the table. In the case of *Galaxias* almost every local stream or lake has its own varieties. A similar variation has been noticed by Macleay and by Ogilby in the New South Wales species of *Galaxias*.

GENERAL CONCLUSIONS.

Ever since it was formed, or existed in anything like its present condition, Bass Straits must have presented a very formidable mechanical barrier to the passage of all land and fresh-water Vertebrates unfurnished with wings. On the other hand, seeing the exceedingly wide continental distribution of such slow-travelling animals as *Trichosurus vulpecula*, *Trachysaurus rugosus*, *Egernia whitii*, *Liatis burtoni*, it seems plain that the Dividing Range in its present state cannot have acted at all as a serious mechanical barrier. But the Dividing Range has been felt in its action on the rainfall. Widely divergent climatic conditions have thus been produced, yielding a humid region in the south-east and a dry region in the north-west. Where the nature of the soil was favourable great forests have flourished, as in Gippsland and in south-west Tasmania. Thus in the one district we have excess of moisture and abundant shade, and in the other lack of moisture and consequent excess of sunshine by day and of radiation by night, all potent factors in animal life. Hence two faunas suited to the two regions. Where this barrier is most perfect the separation of the districts is most sharply marked; in the west, where it gradually disappears, the faunas merge to some extent, but as the presence of the range intensifies the humid conditions on the coast side, there is less mingling of forms than might at first have been expected.

As we have seen from the tables, the characteristic assemblage of animals of the drier area comprises the Jerboa-Rats (*Hapalotis*) among the Rodents; the Jerboa Pouched Mouse (*Antechinomys*), two other Pouched Mice (*Phascologale calura* and *Sminthopsis murina*), and Geoffroy's, or the Black-tailed, Native Cat (*Dasyurus geoffroyi*); the Striped Bandicoot (*Perameles bougainvillii*, var. *fasciata*) and the Pig-footed Bandicoot (*Choeropus castanotis*); the Wallaroo (*Macropus robustus*) and Great Red Kangaroo (*M. rufus*), the Hare Wallaby (*Lagorchestes leporoides*), and the Bridled Wallabies (*Onychogale frenata* and *O. lunata*) among the Marsupials; the Murray Tortoise (*Emydura macquaria*); the Blind Snakes (*Typhlops*), Tree Snake (*Dendrophis*), and the two Pythons, the Carpet Snake (*Morelia variegata*) and Diamond Snake (*M. spilotes*), and among venomous snakes the genera

Furina, *Vermicella* (Ringed Snake), and *Acanthophis* (Death Adder); half-a-dozen kinds of Gecko (of genera *Gymnodactylus*, *Phyllodactylus*, *Diplodactylus*, and *Gehyra*); the snake-like Lizards (*Aprasia*, *Lialis*); *Amphibolurus pictus*; Gould's Monitor (*Varanus gouldii*); the Stump Tailed Lizard (*Trachysaurus rugosus*), and Western Blue Tongued Lizard (*Tiliqua occipitalis*) with a few smaller forms; and lastly the assemblage of fishes of the Murray basin, of the genera *Oligorus*, *Ctenolates*, *Therapon*, *Murrayia*, *Riverina*, *Copidoglanis* and *Chatoëssus*, known as Murray Cod, Murray Perch, Murray Bream, Murray Catfish, etc.

While the number of species in Tasmania is always much smaller than the number in southern Victoria in all the groups except the Fish and perhaps the Mice, the two faunas present a very similar facies. Thus every genus of Marsupial, Reptile, Amphibian, and Fish which is represented in Tasmania, except *Thylacinus* and *Sarcophilus* is met with in southern Victoria. *Thylacinus* and *Sarcophilus* did live on the continent, but have been exterminated by the Dingo. Even the Tasmanian species* are in most cases identical with those of the adjacent portion of Victoria.

The fresh-water and forest forms are characteristically similar in the two regions. The fish scarcely show more than varietal differences. The common genera are *Lates*, *Microperca*, *Girella*, *Chrysophrys*, *Aphritis*, *Agonostoma*, *Gadopsis* (Blackfish), *Prototroctes* (Yarra Herring), *Galaxias* (Mountain Trout), *Anguilla* (Eel), and *Mordacia* and *Geotria* (Lampreys). Professor McCoy pointed out in his Prodromus how absolutely distinct this assemblage is from that of the Murray basin. Mr. R. M. Johnston's "Census of Tasmanian Fish" has enabled us to see how the fish of Tasmania are almost identical with those of Southern Victoria. If, as I have long believed, the Tasmanian Crinias are not separable from the smooth Victorian species with tiny vomerine teeth, then the resemblance of the amphibians of the two regions is as close as that of the fish. Amongst the forest-frequenters the mammals are most prominent and most important. The great Grey Kangaroo, Forester *par excellence*, the Scrub Wallabies

* See Professor Spencer's Address to the Biological Section of the A.A.A.S., Hobart, 1892, for a detailed account of the Tasmanian Fauna.

(*M. ualabatus* and *M. billardieri*) and the Thylacine ranged in the high woods of both regions. The two native cats, the common and the ring-tailed Opossums, and the two Dormouse Opossums (*Dromicia*) are the representatives in Tasmania of an arboreal fauna which is much more strongly developed in South Victoria and Eastern Australia. The Flying Opossums and the Koala, most specialised of all for life among the trees, are wanting altogether in Tasmania. With the exception of the common Opossum, a most enterprising and versatile animal,* the Tasmanian forest forms are absent from north-west Victoria.

From the zoological facts we are able to arrive at some definite conclusions as to the relative age of the two barriers, the Bass Straits and the Dividing Range. The marked distinctness, frequently extending to the genera, of the faunas of the north-west plains and the well-watered south-east hill and coast country points to the long persistence and ancient origin of the Dividing Range. So, going on the zoological evidence only, it seems clear that the Bass Straits were formed sufficiently to serve as an effective barrier *before* the dingo and the most highly differentiated tree-forms had reached southern Victoria, and *after* the forests had been established and the streams stocked with the existing fish, *long after* the separation or evolution of the two Victorian faunas had taken place. During the process of widening and deepening of the Straits, the dingo invaded Victoria, the Thylacine and Tasmanian Devil disappeared, while the Koala and the beautiful Flying Opossums came in from the north along the eastern strip of Australia, and took possession of the Gippsland forests along with a less desirable immigration of the Fruit-eating Bats, and, speaking generally, the present distribution of Vertebrates in Victoria has been effected.

* In Kent Island this animal has in the total absence of trees taken to the ground and lives among the grass tussocks.

Art. VII.—*Description of two new Species of Lizards from Central Australia.*

By A. H. S. Lucas, M.A., B.Sc., and C. Frost, F.L.S.

Ophidiocephalus, gen. nov.

Parietal bones distinct. Tongue nicked at the tip, inferiorly with six longitudinal ridges bearing papillæ. Ear hidden. Rudiments of hind limbs externally. Head with symmetrical plates. Scales smooth, cycloid, hexagonal, imbricate, all similar, subequal. No præanal pores.

Ophidiocephalus adds a new genus to the Australian family of snake-like lizards (*Pygopodidæ*). Its nearest ally is *Delma*. In *Delma*, however, the ear is exposed, and there are two median series of transversely enlarged ventral scales.

O. tæniatus, sp. nov.

Snout very prominent, pointed, as long as the distance behind the eye of the posterior border of the parietals; no distinct canthus rostralis; eye very small, without a distinct circular scaly lid; ear hidden. Tail about once and one-half the length of the head and body. The rudimentary limbs as long as the distance between the eye and the nostril. Rostral large, projecting, triangular, twice as broad as high; nostril pierced between the first labial, the nasal, and the fronto-nasal; a pair of narrow nasals, a pair of narrow fronto-nasals and a pair of large prefrontals; frontal large, hexagonal, about as long as its distance from the rostral; a pair of large parietals; a pair of temporals and a pair of enlarged scales separated by a small azygos scale border the parietals; two supra-orbitals, a loreal, a post-ocular and a series of small scales between the eye, the labial, and the loreal; six upper labials, the fourth below the eye, and five lower labials; mental large, truncate behind; first lower labials narrow, not meeting behind the mental. Sixteen longitudinal rows of scales around the middle of the body, subequal. Dorsal surfaces uniformly cream-coloured; lateral and ventral brownish-grey, each scale with a light border.

Dimensions.

Head...	8 mm.
Width of head	4·5 „
Body...	94 „
Tail	160 „
Hind-limb	2·5 „

Locality.—Charlotte Waters.

Diplodactylus conspicillatus, sp. nov.

Head short, high, convex; snout pointed, deep, longer than the distance between the eye and the ear-opening; canthus rostralis sharply defined; diameter of orbit two-thirds the length of the snout; ear-opening small, rounded. Body moderate; limbs slender, meeting or slightly overlapping when adpressed. Digits not much depressed, with small rounded tubercles below; the apex not dilated, with two small oval plates inferiorly, all clawed. Upper surfaces covered with small granular scales, largest and flattest on the middle of the back. Rostral large, hexagonal, not twice as broad as high, with trace of median cleft above; nostril pierced between seven or eight nasals, the superior and the anterior swollen, the latter largest and transversely dilated, the posterior small, granular; a polygonal plate between the nasals behind the rostral; one anterior upper labial distinct, but all the other scales bordering the gape above and below are quite indistinguishable from the surrounding small granules or scales; mental large, nearly as large as the rostral, produced and rounded behind; no distinct lower labials or chin-shields; abdominal scales very small, not so large as mid-dorsal. Tail short, suboval, discoid, convex above, flat beneath, with rings of small muriform scales, most regular and convex and largest above, flat and imbricate below. No pores. Males with cluster of about eight small conical scales on each side of base of tail. Pinkish-grey above, with irregular, more or less transverse, brownish-black reticulations, a whitish streak along the canthus rostralis; sides and upper surfaces of limbs dotted with creamy-pink; under surfaces whitish, immaculate.

DIMENSIONS.

	A	B
Total length ...	61 mm.	... 73 mm.
Head	11·5 ,,	. . 12 ,,
Width of head ...	8·5 ,,	... 9 ,,
Body	34·5 ,,	42 ,,
Fore-limb	16 ,,	... 16 ,,
Hind-limb ...	18·5 ,,	... 18 ,,
Tail	15 ,,	... 19 ,,

Locality.—Charlotte Waters.

The above lizards were sent to Professor Spencer by Mr. P. M. Byrne, of Charlotte Waters, to whom we are already so deeply indebted for valuable specimens.

We are also indebted to the kindness of Professor Lyle of the University of Melbourne, who secured for us a radiograph of the unique specimen of *Ophidiocephalus taeniatus*, and thus enabled us to determine the distinctness of the parietal bones.

Art. VIII.—*The Temperatures of Reptiles, Monotremes and Marsupials.*

(Plate VI.).

By Alexander Sutherland.

[Read 4th June, 1896.]

There has for many years past been a tendency to diminish or ignore the distinction between the cold-blooded and the warm-blooded types of animal life. Quite a number of writers adopt the habit of speaking of "the so-called cold-blooded animals," as if the contrast were an unfounded belief that increasing knowledge is fast abolishing. Yet the difference is one that is not only real, but in some respects radical. In very few, however, of nature's classes is there found a line of sharp demarcation, and the chief purpose of this paper is to point out that, though the distinction between the two types is real, there lies between these two types a line of steady gradation.

Although the invertebrates have the capacity of producing heat, they are themselves cold-blooded. With the exception of the insects, they very rarely rise more than a fraction of a degree above the temperature of the media in which they happen to be. According to observations of Professor Valentin, polypi, medusæ, echinoderms, molluscs, crustaceans and cephalopods are able to raise themselves about a fifth of a degree, sometimes as much as three-fifths of a degree, above their environment.*

Among insects the power of heat-production is very much greater. Though essentially cold-blooded creatures, in the sense that they have no fixed standard of body-heat towards which they approximate, they are almost always warmer than their media; but if they are at rest that excess is only a degree or two. In case, however, of severe exertion, they are capable of warming themselves to a remarkable extent. George Newport showed that an ants', bees', or wasps' nest at a period when its inmates are dormant will not be more than a tenth of a degree warmer than the surrounding air. But when the insects are roused and excited they are able, by rapid movements of their wings, to warm

* All Degrees in this paper are Centigrade.

themselves and their nests very considerably. As the result of twelve experiments on a nest of thirty bees, Newport found an average elevation of 3·5°; but on seven occasions when he violently agitated them he obtained an average elevation of 5·3°. At times when bees are naturally much excited, as at swarming time, their temperature may rise as much as 22°. According to experiments of Juch and Newport (Phil. Trans., 1837, p. 259), ants in an ordinary state of activity keep their nests some seven or eight degrees warmer than the surrounding air, but when agitated the difference readily rises to twelve or thirteen degrees.

These more intelligent insects apparently make use of this capacity of generating heat for the purpose of quickening the hatching of eggs and the development of nymphs. Nevertheless they are distinctly cold-blooded animals, for at rest they take the temperature of their media, and any elevation is temporary and due to the immediately preceding display of energy.

In the case of fish, amphibia and reptiles the same is true. At rest all of them remain at the temperature of their environment, rising and falling with it, and showing no capacity, however rudimentary, of maintaining a fixed and characteristic temperature; yet all can warm themselves by exertion. The large blue-tongued lizard, which is common in the southern parts of Victoria (*Cyclodus gigas*), can warm himself as much as half a degree in ten minutes of anger. In five experiments of this sort I found that different individuals had different capacities of being irritated, but the average was a trifle under half a degree for ten minutes of exasperation.

By activity, and consequent heat-production, all fish, amphibia and reptiles seem able to keep themselves a little warmer than the air or water in which they dwell. Dutroche tells us (Ann. des Sciences Nat., xiii., p. 20) that the newt can keep itself from 2° to 5½° above the temperature of its medium, the turtle 1½° to 3½°, and the common green lizard of France (*Lacerta viridis*) from 4° to 7°. Max Furbinger asserts that species of blind-worm rise as much as 8° above the temperature of the air. Fish at rest appear to take almost absolutely the temperature of the water wherein they live, but after a struggle, or any other form of energy, they may warm themselves two or three degrees.

This, however, has no real affinity with a warm-blooded habit. And yet these creatures approach in a remote way the

warm-blooded condition by sometimes developing a capacity for heat-production in the action of their viscera. Dumeril has shown that snakes by mere digestion can warm themselves from 2° to 4°, the maximum temperature occurring about twenty-four hours after a meal. Moulting may warm a snake nearly a degree, and frogs, lizards and serpents all warm up with amatory emotion.

Thus it constantly happens that these animals, though essentially cold-blooded, may be observed at temperatures somewhat above that of their environment. But in general that excess is not great, and it leaves the distinction between the warm-blooded and the cold-blooded type quite unaffected.

The true criterion of the difference is of course the concomitance of the temperature of the animal and its medium. An animal of the warm-blooded type may vary a trifle in its general body temperature when the climate alters, but it maintains an almost constant degree of heat. The reptile, though it may maintain itself a few degrees above the surrounding temperature, always varies with it, rising and falling so as to keep always the same number of degrees in excess.

In two experiments I conducted to see how far this concomitancy held, I placed two specimens of the large lizard already mentioned into a small tank of water, so that only their noses were above water. I then warmed up the water at various rates of speed by means of one or more lamps. The following tables will show how closely the lizards followed the temperature of the enclosing water :—

Lizards, Average Weight, 350 Grams.

Time.	Temp. of Water. C.	Temp. of Lizard. C.	Time.	Temp. of Water. C.	Temp. of Lizard. C.
2·30	18·4	18·0	4·15	25·2	24·1
2·45	19·8	18·9	4·30	26·0	24·7
3·0	20·6	19·9	6·15	29·2	28·9
3·15	21·8	20 7	8·0	32·8	31·4
3·30	22·8	21·7	9 0	31·0	29·4
3·45	23·1	22·5	11·0	24·0	23·5
4·0	24·4	22·9			

LIZARDS, AVERAGE WEIGHT, 330 GRAMS.

Time.	Temp. of Water. C.	Temp. of Lizard. C.	Time.	Temp. of Water. C.	Temp. of Lizard. C.
4·20	11·5	12·0	5·10	21·0	19·5
4·25	14·4	13·6	5·15	21·6	19·8
4·30	16·0	14·6	5·20	22·4	20·4
4·35	16·7	15·2	5·25	23·0	20·9
4·40	17·2	16·0	5·30	23·6	21·4
4·45	17·8	16·8	5·40	24·6	22·1
4·50	18·3	17·0	7·0	30·1	28·6
4·55	19 0	17·8	8·0	35·0	33·6
5·0	19·6	18·2	9·30	29·5	28·0
5·5	20·2	19·2	11·0	24·0	23·0

Similar tables might be made out for fish, for turtles, for snakes, and all the cold-blooded animals, showing that they take their temperature absolutely from the media in which they exist, and when it is found that they do not exactly coincide with it, the cause is generally to be found in the fact that for a rising or falling temperature of the medium the animal will not at once respond to the change; it lags behind and will in a cooling medium be warmer, in a warming medium cooler than its surroundings. Occasionally, however, a slight excess of heat is due to the animal's activity.

Cyclodus gigas is a very sluggish creature, and if left alone never warms himself by any exertion, yet if one takes his temperature in the early part of the day it will almost always be found to be below that of the air. After sunset, it is generally higher. During two years I kept specimens of this species in a box, sometimes six or eight, sometimes only two or three. I took their temperatures morning and evening, not altogether continuously, but throughout the larger portion of that time. The average of all these observations gave for lizards 18·1°, for the air 18·4°. This is a very close approximation considering that the temperatures had the wide range that lies between 12° and 32°. The lizards appear to be colder a little than the air. This I believe to be due only to the fact that, taking temperatures before eight o'clock in the morning, the lizards were still considerably in the

rear of the air temperature, while between five and six o'clock in the evening, though they were above the air temperature, the excess then did not wholly balance the morning deficiency.

I am convinced that if one took the temperature of a quiet lizard every hour for a month, the average would correspond almost exactly with the average temperature of the air. The morning and evening observations which I took would give a less exact result, though from them the difference is only three-tenths of a degree.

A cold-blooded animal is therefore one which when at rest takes its temperature almost absolutely from its environment. When a snake is asleep, the slow beat of its heart, eight or ten times in a minute, will generally, so far as I have noticed, keep the muscles of the heart itself about six or eight tenths of a degree warmer than the rest of the body. This, diffused through the whole body, must have a tendency to slightly increase its temperature, but only to a minute extent. The same snake, however, after a time of activity may be two or three degrees above the heat of the surrounding air. Yet even that is inconsiderable compared with the extreme rise and fall of the creature's temperature with the alternations of day and night, of hot or cold weather.

The steps whereby the more active and intelligent warm-blooded types have arisen from this lethargic level would form a fascinating subject for enquiry, but I purpose here only the much easier and more prosaic one of recording that such steps, however caused, do actually present themselves, and that these are in the most perfect accordance with the existing classification, which is based on anatomical considerations alone.

The monotremes are, in consideration solely of their more reptilian anatomy, placed lowest in the scale of mammals. Their low temperature would entirely justify, were justification in any way needed, the position thus assigned them next to the reptiles. The temperature of the duck-billed platypus has been determined by Baron Miklouho-Maclay to be, as the average of three observations, 24·8° when the water in which the animals were kept averaged 22·2°. (Journ. of Linnæan Soc. of N.S.W., VIII., p. 425, and IX., 1204.)

Now, the average of forty-five specimens of the ten higher orders of the mammalia, excluding the monotremes and marsupials, is

38·9°, as calculated from Dr. John Davy's lists (Edin. Phil. Journ. 1825, p. 300), while the average of a similar but shorter list supplied by Max Fürbinger is 39°. We may take this as fairly indicative of the general mammal temperature, which does not, except in constitutional disturbances, vary so much as two degrees on either side of this limit. No mammal indeed seems in good health to be warmer than 40°; scarcely any descend lower than 37°.

The platypus, therefore, at only 24·8° is almost a cold-blooded animal. The only other genus of monotremes, the echidna, carries us a step upwards. Baron Miklouho-Maclay's average of five observations is 28°, while the air was 20°. I have kept at different times fourteen specimens of *Echidna hystrix* and made twenty-seven observations on the temperatures of all I happened to have at any particular time. I found the average to be 29·4°, or nearly a degree and a half above that of the Baron. But these animals show their affinity with the reptiles by a temperature so variable with the weather that we may readily expect the average of one series of experiments to differ very considerably from that of another.

An echidna one cold morning was so low as 22°; another, brought in from the forest in a sack exposed to a fierce midday heat, registered so high as 36·6°. The following table will represent the general character of the variations, the temperatures in each case being the average of from three to six individuals, which never varied from one another at the same time more than a fifth of a degree:—

Echidna.		Air.	Echidna.		Air.
22°	...	14·4°	29°	...	25°
27·5°	...	14°	29·5°	...	22·2°
27·7°	...	14°	29·5°	...	24°
27·7°	...	18°	30·3°	...	18°
28·2°	...	19°	31·1°	...	23·3°
28·3°	...	16·6°	31·4°	...	22·4°
28·7°	...	16°	32·2°	...	31·2°
29°	...	22·7°	32·9°	...	18·6°
29°	...	23°	36·6°	...	45°

This is an immense range for a mammal, and suggests a reptilian want of capacity for temperature regulation. Moreover, though the concomitancy between the air and the body temperatures is by no means strict, there is enough to show that the one in a large measure follows the other. It is to be remembered that while a monotreme may rise and fall with the air, yet the one change will follow the other after a definite period of time, and an hour after sunset, though the air in a box may have grown much cooler, the echidnæ in that box may have only begun to cool.

The temperatures given by Dr. Richard Semon in the recent number of his important work, *Forschungsreisen in Australien*, run as follows :—

Echidna.		Air.	Echidna.		Air.
26·5°	...	21·5°	31·5°	...	18°
29·5°	...	22°	34°	...	31·5°
30·5°	...	18°	34·2°	...	22·5°
31°	...	24°			

Here also the generally low temperature, combined with the wide range, even though it is not strictly concomitant with changes in air-temperatures, seems to suggest affinities with reptiles.

The next stage in the anatomical classification brings us into the order of the marsupials, and here again we make an upward step in view of a temperature higher, but not so high as that of mammals in general; steadier, but not so steady as is usual in all the remaining orders. I have observed the temperatures of sixteen different species of marsupials, and they average 36° exactly, as the result of 126 observations. They are thus 3° below the average of other mammals.

The marsupial whose temperature, so far as I have observed, comes next above the monotremes is the wombat, which stands at 34·1°, as the average of single observations made on two specimens (*Phascolomys lasiorhinus*, 34·3°, and *P. platyrhinus*, 34°). Next seems to stand the genus Petaurus, or flying squirrel. Mr. Ernest Le Souëf was good enough to observe for me the temperatures of five specimens in the Zoological Gardens of Melbourne. The average is 35·7°.

After that comes the genus Phascolarctos, our little native bears or koalas. I have kept numerous specimens of this animal (*P. cinereus*) on his native gum trees, with nothing artificial about him save a strap and rope whereby he could be pulled down from time to time to have his temperature observed. Thus I made eighty-three observations, the average of which amounts to 36·4°. Females at the breeding time are always very decidedly above the ordinary degree of warmth. If such cases be excluded, the average is exactly 36°. But the average for males alone is only 35·2°. The range of variation may be seen in the following nine observations taken at intervals upon the same female :—

Koala.		Air.	Koala.		Air.
35·0	...	7·7	36·0	...	13·1
35·2	...	11·5	36·1	...	22·0
35·6	...	10·0	36·5	...	24·5
35·7	...	19·0	36·8	...	16·0
36·0	...	22·0			

The range is here seen to be not very wide, yet I have often known healthy specimens that had been for a while in the sun stand as high as 37·9°, while on a cool day or in a very shady place the same individuals would be only 35·3°, a range greater than we would find under the same circumstances in any of the higher mammals. The highest register I ever obtained for a thoroughly healthy koala was 38·4°, which is a degree and a half above the normal temperature of man ; the lowest was 34·9°, or nearly two degrees below man's normal. The former temperature would in man imply some constitutional derangement, a distinct case of feverishness ; in the koala it denotes only that it has been out in the sun. The lower temperature, though common in the koala, is never met with in man except in rare pathological conditions. It is below the range of our ordinary clinical thermometers.

I found that a big male specimen of this species, kept in a cool shady place and registering 34·9°, could, by being brought into a bright sun, be raised a tenth of a degree for every five minutes he was kept in it. I regret that when I had abundant opportunities I did not determine how far this warming process would go ; but I have seen it continue for more than two hours at a time.

Females were, with only one exception, of higher temperature than males when under the same conditions; and the divergence was always greatest when the females were suckling their young, the average of twenty-five observations giving an excess of 1·2°. The koala has only one young one at a time, but she has two teats, one on each side of her pouch; of these only one would be functional at a time. That side of the pouch whereon was the functional teat was invaribly warmer than the other. The average of twenty-six observations gave 36·6° for the one side as against 36° for the other.

According to observations taken for me by Mr. Ernest Le Souëf the Dasyures come next at an average of 36°.

Phalangers stand next in order. The average of twenty two observations on from two to four specimens of the ring-tailed opossums (Phalangista) gave 36·6°, which is only a little below the normal human temperature. But again the range was much greater than one finds in any of the higher mammals. In cool weather, with the thermometer at 16·8°, a male would register about 35°, a female about one-tenth of a degree higher; but in warmer weather, though still in the shade, where the thermometer registered 31° to 35°, the opossums would be about 37°; I once observed two of them, the only ones I then had, for nearly a fortnight together, which averaged about 39°, but as they died soon after, I fear they had not been in good health when these records were made.

Mr. Ernest Le Souëf took for me the temperatures of three of these Australian opossums in the Melbourne Zoological Gardens. *Phalangista vulpina* gave 36·1°, *Phalangista fuliginosa* 37·3°. This corresponds with Selenka's observations of the true opossums (Didelphys), which ranged about 37°.

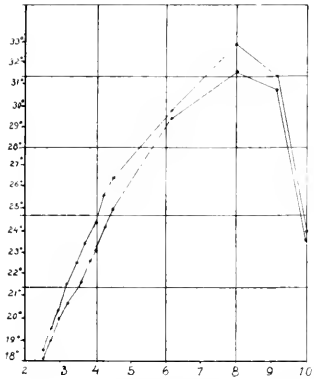
I have made only four observations on the temperatures of the kangaroo family. They are a little under the human standard. *Macropus giganteus* gave 36·6°, *Halmaturus bennettii* gave 37·1°, *Petrogale xanthopus* 35·9°, while the tree kangaroo (*Dendrogalus grayi*) was exactly at the human standard, 37°.

From the few recorded temperatures of rodents and insectivores, I should think it most probable that they came next in order, with perhaps the cetacea and sirenia, judging from occasional records, as almost on the same level. All the other orders of mammalia stand uniformly much above the human temperature.

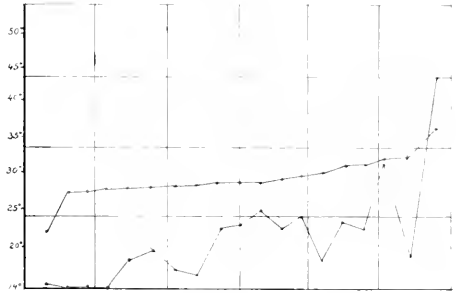
It is clear, therefore, that there are grades of temperature, and that the mammals which are classed lowest on anatomical grounds are not only of the lowest temperature, but also of the greatest range, and they are likewise, of all mammals, those which are under the strongest and most direct influence of the temperature of the environment.

Similar, though much less complete connecting links may be seen in the case of birds. The lowest of birds are the Ratitæ, or Cursores, and these appear to have the lowest temperature. Mr. Ernest Le Souëf, with an amount of obliging trouble which may be conceived, took for me in the Melbourne Zoological Gardens observations on the temperature of the emu. These are the lowest records of bird temperatures of which I know. They averaged 39·5°, while all the birds above the Ratitæ are invariably over 40°. The temperature of thirty-six fowls, taken quietly by night from their perches, averaged 41° exactly, while that of twelve, lifted from the nests in which they were brooding, was 41·4°. Numbers of fowls caught while roaming about averaged 41·3°, but these of course were always warmed up previously by a little violent exercise. Turkeys stand about the same level; ducks are stated, on good authority, to be lower; but I have found for these birds, from a fairly large number of observations, an average of 42·1°. The temperatures of birds of the more intelligent orders is generally somewhat higher. If we exclude the birds of prey, we might say that in all orders above the anseres, grallæ and gallinæ the temperature ranges over 42°. It would be a matter of interest to secure some observations of the temperature of the apteryx, in order to determine whether the lowest of birds shows by its body warmth in some degree the same reptilian affinity which the monotremes exhibit. In that case there would be reason to believe that the rest of the Ratitæ would correspond closely to the Marsupials, being a connecting link, but much closer to the higher forms than to the lower.

In a very general way, and not forgetting numerous limitations and contradictions, it may be said that bodily activity depends on body temperatures, that creatures such as insects, and reptiles are active only when warmed up from without, but become torpid with decreasing temperature. The type in which activity is generally habitual, maintains its own body temperature. This is



To show concomitance of temperatures of Lizards and Water
Upper Line Temperature of Water (deg. Cent)
Lower Line Temperature of Lizards



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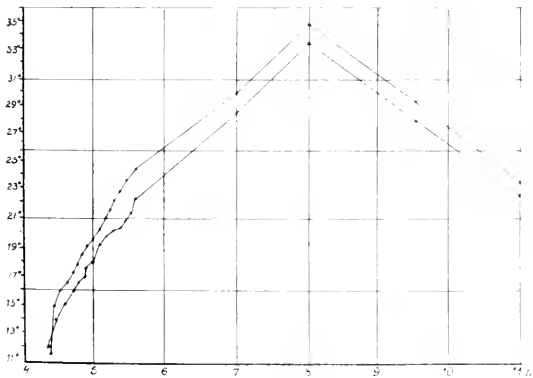
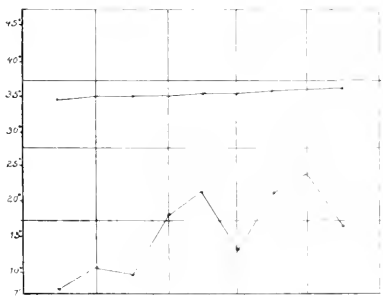
[illegible] Echidna and air
Upper Line Echidna
Lower Line Air



With more rabid heating



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Upper Line [illegible]
Lower Line air

seen in the mammals, but more still in the birds. But this warm-blooded active condition was produced by no sudden emergence; the monotremes and marsupials form a gentle gradation between the reptile and the carnivore or ungulate; while, so far as indications point, there is reason to believe that the lower birds still are reminiscent of a once existent chain of links which equally joined the cold-blooded lizards to those warmest-blooded of all creatures, the passeriformes and fringilliformes.

Art. IX.—*A Locality List of all the Minerals hitherto recorded from Victoria.*

By John A. Atkinson.

[Read 13th August, 1896.]

Introduction.

In offering this list of minerals found in Victoria, I do not claim to have made any fresh records; but rather to have collected into one paper the records that are spread over a great many different publications. New South Wales has its list in Professor Liversidge's "Minerals of New South Wales," and a supplementary list in the "Report of the Second Meeting of the Australasian Association for the Advancement of Science, 1890." Queensland, South Australia, and New Zealand, have their lists also in the last-named work, and Tasmania has a list published by Mr. W. F. Petterd in 1893, while the most recent list of Victorian minerals was many years old, and, in consequence, incomplete, inasmuch as it did not contain the records of the last twenty years or more.

Having felt the want of such a list, and having time to spare, I acted on the advice of gentlemen interested in mineralogy, and undertook to search for all the published records and include them in one catalogue. The object was not only to enumerate all the minerals, but, as far as possible, also all the localities where they were found, either in large or small quantities, and to give the reference to the original record. The work demanded much more time and labour than I anticipated, but I have derived much pleasure and not a little profit from it, and the number of books and papers I had to go through to find the records shows how badly the work needed doing. It is a pity that some professional mineralogist had not taken the work up, or, being left to an amateur, that a more able man had not undertaken it. I feel this the more when I contrast it with the list published in 1866 by Professor Ulrich, who seems to have done most of the work of this kind in Victoria.

Very many interesting particulars were given in connection with some of the records, and I should have liked much to include them in this paper, but space would not admit of it, and thus, in some respects, it may be looked upon as but an index to the mineral records.

I have had a difficulty in fixing the mineralogical names for some of the records, and in some cases I have not been able to decide the correct species at all, as the composition alone was given, *e.g.*, "carbonate of copper," "oxide of iron," "lead ore," etc. This prevents me from being able to state accurately the number of distinct mineral species recorded from Victoria, but I calculate it to be somewhat over 200. Mr. W. F. Petterd in the introduction to his "Catalogue of the Minerals of Tasmania, 1893," calculates that New South Wales has about 185 species, New Zealand about 172, Queensland about 101, and South Australia about 100; so that Victoria seems to rank highest of the colonies in the number of its mineral species.

I have to thank Mr. G. B. Pritchard, and Mr. T. S. Hall, M.A., for much valuable assistance in connection with this paper; also Messrs. A. W. Howitt, F.G.S., O. R. Rule, late of the Technological Museum, A. Purdie, of Ballarat School of Mines, and D. Clark, of Bairnsdale School of Mines, for advice, suggestions, records, etc., which they kindly gave me.

List of Abbreviations.

Bl. 1866 - -	Rev. Dr. Bleasdale, in Official Record of Melbourne Intercolonial Exhibition, 1866.
B.S. 1866 - -	R. Brough Smyth, in Official Record of Melbourne Intercolonial Exhibition, 1866.
B.S. 1872 - -	R. Brough Smyth, in Official Record of London International Exhibition, 1873, Melbourne, 1872-3.
B.S. 1861 - -	R. Brough Smyth, in Catalogue of Victorian Exhibition, 1861, with prefatory essays.
Cl. - - - -	Donald Clark, B.C.E., of North Gippsland School of Mines, in Report of Australasian Association for the Advancement of Science, 1892.

Chem. News -	Chemical News.
Geo. Sur. $\frac{1}{4}$ sheet.	Geological Survey of Victoria, quarter sheet.
G.S.N.S.W. -	Records of the Geological Survey of New South Wales.
H. - - - - -	A. W. Howitt, F.G.S.
H. 1896. - -	Notes on Diabase and Adjacent Formations of the Heathcote District, by A. W. Howitt, published as a Special Report by the Department of Mines, Victoria, 1896.
L. 1873. - -	Official Record of the Victorian Court of the London International Exhibition, 1873.
M. 1866. - -	G. H. F. Ulrich, in Official Catalogue of the Melbourne Intercolonial Exhibition, 1866.
M. 1870. - -	G. H. F. Ulrich's "Contributions to the Mineralogy of Victoria," in Papers presented to Parliament, 1870, Second Session, Vol. 2; also published separately.
M.R. - - -	Reports of the Department of Mines, Victoria.
M.H. - - -	Miners' Handbook, issued by the Department of Mines, Victoria, 1894.
M.S. - - -	Mineral Statistics published by the Department of Mines, Victoria.
M.R.F. - - -	Catalogue of Minerals, Rocks and Fossils, collected in the Colony by the Mining Department, 1866.
N.M. - - -	Catalogue of the National Museum, Melbourne, 1868.
P. - - - - -	Papers presented to Parliament, Victoria.
P.R. - - -	Progress Reports of the Geological Survey of Victoria.
Pr. R.S. Vic. -	Proceedings of the Royal Society of Victoria.
Pd. - - -	Mr. A. Purdie, M.A., of Ballarat School of Mines, in private correspondence.
R.A.M.S. - -	Records of Australian Museum, Sydney.
Sel. 1861. - -	Dr. A. R. Selwyn, in Catalogue of Victorian Exhibition, 1861, with prefatory essays.
T.M. - - -	The cases in the Technological Museum Melbourne, or in the Catalogue of the same, 1894.

T.S.H. - - - T. S. Hall, M.A., in Proceedings of the Royal Society, Victoria, 1895.

Trs. R.S. Vic. - Transactions of the Royal Society of Victoria.

Trs. R.S.S.A. - Transactions of the Royal Society of South Australia.

V. 1873. - - Official Catalogue of the Victorian Exhibits at the Vienna Exhibition, 1873, bound with Official Record of the London International Exhibition, 1873, Melbourne, 1872–3.

ACTINOLITE.—Near Heathcote, in diabase rocks (H. 1896).

ADAMANTINE SPAR (Hair-brown Sapphire).—Blue Mountain and Beechworth districts, washed grains in the gold-drifts. (M. 1866). Mornington (T. M.).

ADULARIA.—Reid's Creek, Beechworth, small pieces in druses (M. 1866).

AGALMATOLITE.—Keilor Plains, nodules in basalt. (Sel. 1861). Keilor and Gisborne, in basalt (M. 1866).

AGATE.—Beechworth creeks; Yarra basin; several parts of Gippsland; Murray River near Wodonga, very frequent. Banded varieties, "*Fortification Agate*," "*Landscape*," and "*Moss Agate*," are not rare. Cape Otway Coast (M. 1866). Near Berwick; near Dandenong (M. 1870). Yarra Ranges (B.S. 1866). Beenak (P. 1883). Warburton (P. 1891). Boggy Creek; Baldhill, with crystals of quartz interlaced (Cl.). Koroit Creek (T.M.). Avoca; Chiltern; Mouth of Gellibrand River; Lake Cooper; Sassafras Creek (P.R. Vol. 3). Woori Yaloak Creek (V. 1873). Near Kilmore (Geo. Sur. $\frac{1}{4}$-sheet 4 N.W.).

ALBIN (variety of apophyllite).—Harcourt granite quarries, in druses (T.S.H.).

ALBITE.—Blacksmith's Gully Reef, Fryerstown, in veins and druses of fine crystals (analysis of this felspar by C. S. Wood in National Museum Catalogue, 1868); Eaglehawk Reef, Maldon; Tarilta, in a syenitic rock (M. 1866). Kyneton (Sel. 1861). Cape Woolomai (P. 1878). Francis Ormond; Garfield; Crown Nimrod; Coomb's

Gully; and other mines in the Castlemaine District (T.S.H). "The felspar of a very silicious granite, with a vein of cassiterite, near Beechworth, appears to be albite" (P. 1870). Bendigo (P.R. Vol. 3). Near Heathcote, in diabase rocks (H. 1896).

ALMANDITE.—Ovens; Ballarat (Bl. Trs. R.S. Vic., 1865-6).

ALLOPHANE.—"The partly decomposed basalts and the clays of the gold-drifts, and the fossiliferous tertiaries around the coast, are generally very rich in nodules and veins of amorphous silicates of alumina and magnesia, of uncertain, *i.e.*, variable, composition; specimens resembling allophane, halloysite, meerschaum, &c., have been found at many places (M. 1866). Hampshire Reef, Golden Point, forms kernels in a loose sugary mineral in the caps of the reef. The loose sugary mineral is probably a variety of allophane (M. 1870). Pleasant Creek; Strathloddon (P.R. Vol. 3).

ALUNITE.—Near Magnet Hill, Gisborne, nodules and crusts in a basalt quarry (M. 1866). Sunbury in black pyritous shales (N.M.). Gisborne and elsewhere on the goldfields (B.S. 1872).

ALUNOGEN.—Barker's Creek slate quarries near Castlemaine, as a thick efflorescence (T.S.H.).

AMETHYST, OR AMETHYSTINE QUARTZ.—Beechworth district, in the drifts, or in the veins traversing granite; Bradford Lead, Maldon, in the drifts. "The light colour of the Maldon specimens makes the designation 'Rose Quartz' more applicable" (M. 1866). Chiltern, druse cavities in granite (T.M.). Bendigo; Linton; Upper Yarra; Yackandandah (P.R. Vol. 3).

AMETHYST, OR ORIENTAL AMETHYST (Corundum).—Pakenham (M. 1870). This specimen was a hexagonal prism with rhombohedral planes (N.M.). Beechworth; Dandenong; Stockyard Creek (P.R. Vol. 3). White amethyst at Beechworth (Bl. Trs. R.S. Vict. 1865-6).

AMPHIBOLE.—See *hornblende.*

ANALCITE.—Phillip Island, in amygdaloidal basalt (M. 1866). Phillip Island, in regular trapezohedrons in older basalt (N.M.). Chambers' quarry, Richmond, as trapezohedrons (M. 1870). Flinders (T.M.).

ANATASE.—Latrobe River, Gippsland, in the tin sand (P. 1874). Beechworth (L. 1873, p. 199).

ANDALUSITE.—Tongio West, Swift's Creek, Gippsland, the first discovered in Victoria (P. 1878). Upper Murray; Maldon, crystals in granite (T.M.) Ararat; Inglewood; Pyrenees (P.R. Vol. 3). *Chiastolite* is recorded from near Geelong (T.M.) *Silicate of alumina*, Amherst (V. 1873).

ANDESINE.—Near Heathcote, in diabase rocks (H. 1896).

ANGLESITE.—Wilson's Reef, St. Arnaud; Glen Dhu Reef, Landsborough, sparingly in small, rather imperfect crystals in cavities (M. 1866). In the mineral veins throughout the colony (B.S. 1866). Buchan, from oxidised galena (Cl.). Dargo High Plains (P. 1872).

ANKERITE.—Phillip Island, in older basalt. In this rock there occur narrow veins and irregular patches of a dense, light, greenish-yellow mineral, which proved on analysis closely related to "*ankerite*" (M. 1866).

ANTIMONY (NATIVE).—Maldon, in a metamorphosed vein in Silurian sandstone (P. 1873). Dunolly (M.R. 1889). Near Mansfield (P.R. Vol. 7). Cashel, near Shepparton (T.M.).

APATITE.—Dunolly, light greenish grains in quartz; Bass Strait, an impure variety in nodular concretions is sometimes found in the guano deposits of several small islands (M. 1866). Phillip Island, crystals in older basalt (T.M.). Bruthen Creek; Dargo basalts; Taberraberra (Cl.). Eaglehawk Reef, Maldon (P. 1875–6). Maldon, with calcite, dolomite, etc. (P. 1875–6). Near Heathcote, in diorite and diabase rocks (H. 1896). *Phosphate of lime* occurs at Beechworth and Dunolly (P.R. Vol. 3). *Phosphate of lime with silica and alumina* occurs coating cavities in decomposed basalt at Bruthen Creek, Gippsland (N.M.).

ARAGONITE.—In druses of radiating acicular crystals in the newer pliocene basalts; near Talbot; Taradale; Daylesford, &c.; in hollows of the older pliocene gold-drifts; well developed crystals in hollows of the freshwater limestone, at Muckleford Creek, near its junction with the Loddon

River; nodules in the basalt of Kyneton, Malmsbury, and Taradale, often with a thin glassy coating of hyalite (M. 1866). Sunbury, in basalt; Kilmore, in basalt; Richmond, in basalt; Ballan; Lisle's Reef, Maldon, on metamorphic sandstone (N.M.). Collingwood, basalt quarries (P. 1880). Flinders (T.M.). Riddell's Creek (P. 1883). Hustler's Reef, Bendigo (P. 1878). Phillip Island, in older basalts (P. 1877–8). Ballarat, in basalt; Bendigo; near Newstead; Smythesdale (T.M.). Ararat; Dunolly; Guildford; Keilor; Majorca (P.R. Vol. 3). Maude, Moorabool Valley (Pr. R.S. Vic., 1895, p. 187. See also ¼-sheet 19 S.W.).

Argentine (lamellar calcite).—German Reef, Maldon (T.M.).

Argentite.—Ebenezer Reef, Morse's Creek, with galena, blende, arsenical pyrites, and gold (M. 1866). St. Arnaud, with galena, blende, native silver, copper, anglesite, mimetite, sulphur, ores of iron and of manganese (B.S. 1866). In P. 1870, Mr. Newbery reported, "No pure sulphide of silver, as a distinct mineral, has yet been found in Victoria."

Arseniate of Iron.—See *Pharmacosiderite.*

Arsenolite.—Bethanga (P. 1880).

Asbolite (earthy cobalt).—Cape Patterson, in shrinkage cracks of older volcanic rocks; Thomson River Copper Mine; Yea (B.S. 1872). McKenzie's diggings; Goulburn River (T.M). Alexandra; Glen Dhu; Merton; Strathloddon; Tarrengower; Gippsland (P. 1868). Little Dorrit Reef, Grant (P. 1871). Upper Yarra (P. 1876). Boggy Creek; Mount Taylor; Dargo (Cl.). Costerfield; Crooked River; Dunolly; Griffith's Point; Maldon; Snowy River (P.R. Vol. 3). A report on this mineral by Mr. J. C. Newbery is in the Catalogue of the National Museum, Melbourne, 1868. See also *Wad.*

Asphalt.—See *Bitumen.*

Asteria.—Beechworth, grey or bluish-grey, with six-rayed stars well developed (M. 1866). Eldorado; Ovens (Trs. R.S. Vic., 1865–6, pp. 80 and 81). A green star sapphire from Ovens (Trs. R.S. Vic., 1865–6, p. 79).

Augite.—One of the principal constitutents of our basalts; Malmsbury, small, black, acicular crystals in dolerite; near Black Hill, Kyneton, imperfect crystals in scoriaceous lava. "From its appearance, cleavage, &c., and the result of a quantitative analysis by Mr. J. C. Newbery, there is good reason to suppose that the dark green component of the greenstone (diabase) of the Barrabool Hills, near Geelong, is augite" (M. 1866). Foot of Mount Wallan; near Steglitz, crystals; Mount Hepburn, in basaltic ash; west side of Mount Moorakyle (M. 1870). Magnet Hill; Mount William; Dargo High Plain; Turton's Creek (P.R. Vol. 3). Dargo, in dyke rock (H. in Trs. R.S. Vic., 1887). Near Heathcote, in diabase (H. 1896).

Automolite (Variety of Spinel).—Ballarat; Ovens (Trs. R.S. Vic., 1865–6).

Axinite.—Dookie (T.M.).

Azurite.—Thompson River Copper Mine, Walhalla; Steiglitz; Pyreeth Creek; St. Arnaud; Glen Dhu Reef, Landsborough; Nicholson's Reef, Castlemaine (M. 1866). Blue Mountain; Bendigo; Inglewood; Dunolly (B S, 1866). Dedduck, in quartz vein (P. 1873). Between Koetong and Bright (P. 1875–6). Bethanga (P. 1886). Buchan; Wombat Creek (Cl.). Mount Korong; Lerderderg River, in slate (T.M.). Crooked River (P.R. Vol. 3). Carbonate of copper, without stating which kind, has been recorded from the following places:—Bruthen Creek; Maldon; Broken River; North Gippsland (P. 1868). Buchan; Livingstone Creek; Snowy River; Snowy Creek, near Omeo; Nicholson River; Murindal River (B.S. 1872). Rodney's mine, near Ballarat (P. 1873). Beaufort; Blackwood; Grampians; Kingower; Upper Murray; Smythesdale; Taradale; Wongungarra River (P.R. Vol. 3).

Balas Ruby.—See *Spinel Ruby*.

Barite.—Swiper's Reef, Maldon, very rare, in cracks and crevices of the quartz, partly in crystals, and partly in drusy coatings (M. 1866). Devonshire Mine, Castlemaine, rare, platy crystals in quartz (T.S.H.). Maldon, with

heulandite. A spectrum analysis by Mr. Ellery showed a faint trace of strontia (M. 1870). Dedduck, vein in granite (P. 1873). Richmond, in basalt (P. 1877–8). Woods Point (P. 1881). Gibbo River, containing galena and silver; Mitta Mitta (M.R. 1884). Omeo (M.R. 1887). Boggy Creek, Gippsland, in vesicular ferro-manganese ore; Buchan (Cl.). Back Creek; Ringwood; Dookie; Upper Murray; Phillip Island, in older basalt (T.M.). Alexandra; Beechworth; Fitzroy Range; Murindal River; Snowy River; Tubbut (P.R. Vol 3). Geelong (L. 1873). St. Arnaud? (M.R.F.).

Barklyite.—Beechworth district (M. 1866).

Baryta Carbonate.—See *witherite*.

Basanite.—Beechworth Creeks, in drifts; Cape Otway coast, near Gellibrand River, a pebble deposit; Joyce's Creek, near Newstead; near Wickliffe, veins in Silurian rocks (M. 1866). Mansfield (P. 1887). Heathcote; Mount Stavely; Ararat; Loddon River, near Maldon (T.M.). Turton's Creek (P.R. Vol. 3). Walhalla (P.R. Vol. 4).

Bastite.—Near Heathcote, in diabase rocks (H. 1896).

Beryl.—Pilot Creek (P. 1878). Dargo River; Dry Creek; Mansfield (P.R. Vol. 3).

Beudantite.—Port Phillip Company's Mine, Clunes (P. R. Vol. 3).

Bindheimite.—Murindal, Gippsland (Pr. R.S. Vic., Vol. 16, 1880, p. 145).

Binnite.—Wombat Creek (Cl.).

Biotite.—Eureka Reef, Castlemaine, large hexagonal plates in a basaltic dyke; Castle Reef, silvery white in diorite porphyry; the mica at Raspberry Creek, Woods Point, may also belong to this species (M. 1866). Harcourt, in a dyke; Burn's Reef, near Castlemaine, in a dyke; Mount Alexander, in granite (T.S.H.). Mount Taylor, in quartz porphyries; Marengo Creek (Cl.) Fiddler's Reef, Forest Creek, in a decomposed basalt dyke (N.M.). Phillip Island, in older basalt (T.M.). Sultan Mine, Blackwood (P.R. Vol. 3). Near Heathcote, in granite (H. 1896).

BISMITE.—Maldon; Wombat Creek (P. 1868). Omeo district, rolled fragments (P. 1874). A mixture of the oxide and carbonate of bismuth is found in the Beechworth creeks, associated with tin sand (P. 1872). Snowy Creek P. R. Vol. 3).

BISMUTH.—Wombat Creek, Omeo; Upper Yarra; Ramshorn Gully, in irregularly-shaped pieces of a few dwts. to 1 lb. in weight; Kingower (M. 1866). Linton's, quite pure, from quartz reef (B.S. 1872). Crossover, Gippsland (T.M.). Beds of streams in Omeo district (P. 1874). Beechworth (M. 1870). Snowy Creek, a specimen coated with oxide and carbonate of bismuth, and ferruginous clay (P. 1875–6). Wilson's Reef, St. Arnaud (P. 1884). Maldon (P. 1877–8). Dandenong; Costerfield (P.R. Vol. 3).

BISMUTHINITE (Bismuth glance).—Linton's, with native bismuth, etc., in scaly, slender, prismatic crystals of fibrous or foliated structure (M. 1870). Wombat Creek; Baldhill Creek, Gippsland (Cl.). Beechworth (T.M.). Maldon, in quartz, with gold and maldonite (P 1875–6). Near Linton's, in a quartz reef (P. 1870).

BISMUTHITE (carbonate of bismuth).—Tin-Kettle Lead, Ramshorn Gully; Sandy Creek, Maldon; also reported from Kingower (M. 1866). Linton's; Beechworth (M. 1870). Clunes; Maldon (N.M.). Wombat Creek (P. 1868). Bem River (Combying Creek), Gippsland (P. 1874). Bismuth carbonate also recorded from Omeo district (P. 1874). Snowy Creek (M.H.). An analysis by Mr. J. C. Newbery is in the Catalogue of the National Museum, 1868.

BITTER SPAR.—See *dolomite*.

BITUMEN.—Specimens found in Western Port and Portland districts; Grampians, and Pyrenees, a peculiar kind in small caverns and on ledges of rock (M. 1866). See note on this in Catalogue National Museum, 1868, p. 90. Cowwarr (M.R. 1890). Near Bridgewater (M.R. 1889). Traralgon (P.R. Vol. 7). Coal Creek (N.M.).

BLEISCHWEIF (See galena). Buchan (P.R., Vol. 3).

BOG IRON ORE.—See *limonite*.

Bornite.—Thompson River Copper Mine, distributed through the copper pyrites (M. 1866). Buchan, with chalcopyrite (Cl.). Ballarat gold-drifts; McIvor gold-drifts; Steiglitz; Bethanga; Costerfield (M. H.).

Boulangerite.—Ballarat, in quartz reef, with chalcopyrite and gold (M. 1866). Blackwood, with pyrite, galena, and antimony (P. 1870). Swift's Creek, with pyrites (P. 1879–80). Snowy Creek; Steiglitz (P. R., Vol. 3).

Bournonite.—Ballarat; St. Arnaud; Steiglitz, etc., finely impregnated in some of the quartz reefs; Costerfield antimony reef, in crystalline grains, apparently very rare (M. 1866). Walhalla (P. 1873). Heathcote, at the head of Golden Gully (T.M.). North Gippsland, with gold (P. 1873). Wallan (P.R. Vol 3).

Brookite.—Baw Baw diggings, in quartz (M. 1866). Steiglitz; Mount Greenock lead (M. 1870). Latrobe River, in tin sand (P. 1874). Yarra Flats (T.M.). Broadford (M.R. 1889). Beechworth (P.R. Vol. 3).

Brown hematite, brown iron ore, or brown ochre.—In tertiary rocks around the coast, and occasionally in hollows of quartz reefs (M. 1866). See *limonite*.

Brown Spar (ferruginous dolomite).—Bendigo and Walhalla, in quartz (B.S. 1872). Woods Point (M. 1870). Beechworth; Clunes; Mount Timbertop (P.R. Vol. 3). Gaffney's Creek; Jameson (L. 1873). See *dolomite*.

Brushite.—Skipton Caves, near Ballarat, in guano deposits (P. 1878).

Bucholzite.—Moroka Valley, Gippsland, in granite (M. 1866). Swift's Creek (P. 1878). See *fibrolite*.

Cacholong.—Stawell (P.R. Vol. 3).

Cadmium.—St. Arnaud, with silver and sphalerite (P. 1873). Bruthen Creek; Costerfield (P.R. Vol. 3).

Cairngorm.—Beechworth; Tarrengower; Upper Yarra; in quartz veins traversing granite, and in the drifts (M. 1866). Ovens (Sel. 1861). Maldon (M. 1870). County Evelyn (P. 1877–8). Gibraltar diggings, near Berlin (P. 1878). Castlemaine (T.M.). Gippsland (P.R. Vol. 3). Smoky quartz is also recorded from Harcourt granite quarries (T.S.H.).

CALCITE.—On the goldfields of Victoria; Maldon, crystals in druses in quartz; Malmsbury, in basalt with chabazite; Phillip Island, in basalt; Muckleford Creek, in fresh-water limestone; Barrabool Hills; Cape Otway; Western Port; Traralgon; Geelong, in drift beds (M. 1866). Ararat; Richmond; and Clunes, in basalt; Moe's Swamp (M. 1870). Buchan, in limestone; Wombat Creek with galena; Bindi, in limestone, and as marble; Tambo; Nicholson River; Bairnsdale (Cl.). Ajax Mine, Castlemaine, rhombohedral and massive; Wattle Gully, crystals (T.S.H.). Geelong, in limestone; Guildford and Keilor, in basalt; Preston Vale, in granite; Kyneton (N.M.). Walhalla (B.S. 1872). Maldon (P. 1875–6). Collingwood, in basalt; Riddell's Creek (*ferro-calcite*); Pentridge (T.M.). Jan Juc; Curdie's River (P. 1884). Bendigo (P.R. Vol. 7). Ballarat (M.R. 1889). Near Lorne (M.R. 1890). Warrnambool (Pr. R.S. 1891, p. 95). Charlotte Plains (P. 1891) Chetwynd, in older basalt; Collingwood, as *rock milk;* Maldon, as *Argentine;* Western Port; Flinders, in basalt; Mornington; Campaspe River; Gippsland Lakes; Dookie; Heywood; Lilydale (T.M.). Generally distributed (Sel. 1861). Running Creek (P.R. Vol. 5). Brunswick quarries (P.R. Vol. 6). Clunes; Moyston; Bendigo; Woods Point; Tyers River; Waratah Bay (P.R. Vol. 3). Near Heathcote, in diabase rocks (H. 1896). *Calc-sinter* is recorded from Gippsland (P. 1887), and Collingwood, in basalt (T.M.).

CARBONATE OF SODA (anhydrous).—Lal Lal (P. 1885).

CARNELIAN.—Sparingly as small pebbles in drifts of the Beechworth creeks; Yarra Basin; several parts of Gippsland; Murray River, near Wodonga (M. 1866). Woori Yaloak Creek (V. 1873).

CASSITERITE.—Omeo district, in the creeks; tributaries of the Yarra River; Latrobe River; Thompson River; Gullies in the Strathbogie Ranges; Taradale; many places in Gippsland (M. 1866). Eldorado; Woolshed; Sebastopol; and other places in the Beechworth district;

Ovens; Little Yarra basin, with titaniferous iron sand; Cape Otway district; Tarwin River; Crossover Creek, Gippsland; near Daylesford; near Colac; Chiltern; Cudgewa Creek; other creeks running into the Murray River (B.S. 1872). Indigo Creek, as black sand (P. 1869). Koetong Creek; other creeks rising in the same ranges; Tarwin Creek; Upper Murray; many districts in North-Eastern Victoria and Gippsland (P. 1873). Mount Fatigue; Mansfield; Burrawa Creek; Muddy Creek, South Gippsland; Bright (P. 1874). Franklin River; Stockyard Creek (P. 1875–6). Traralgon Creek (P. 1876). McCrae's Creek; Slaty Creek, Gippsland (P. 1877–8). Morwell River (P. 1878). Bass River district (P. 1881). Benambra (T.M.). Talangatta Creek; Pioneer Creek; Acheron River; Malmsbury, with metallic tin; Bunyip Creek (P. 1882–3). Between Bruthen and Buchan; Gembrook (P. 1883). Mount Bulla; Neerim (P. 1884). Wendouree (M.R. 1889). Agnes River; Snowy Creek (M.R. 1890). Mount Taylor Creek; Mount Wills, in porphyritic dykes; creeks flowing into Mitchell River (Cl.). Islands in Bass Straits; Berwick; Dry Forest Creek; Lerderderg River; Mount Gowar; Myrtleford Creek; Steiglitz; Tangil River (P.R. Vol. 3). Pakenham; Possum Hill (P.R. Vol. 4). Kiewa River (P.R. Vol. 5). Beenak; Bishop's Creek; Jingellic; Black Mountains (P.R. Vol. 7).

Cat's Eye.—(?) Beechworth and Yarra basin (M. 1866).

Cerium phosphate.—Strathbogie Ranges; Bethanga; Gippsland (T.M.).

Cerussite.—In mineral veins throughout the colony (B.S. 1866). St. Arnaud, tolerably abundant in the silver reefs; Nicholson's Reef, Castlemaine; Glen Dhu Reef, Landsborough (M. 1866). Linton's; Maryborough; Pleasant Creek; Gippsland (P. 1870). Between Koetong and Bright, with carbonates of copper (P. 1875-6). Harrietville, with galena (P. 1876). Bethanga (P. 1878). Swift's Creek (P. 1880-1). Murrindal (T.M.). Omeo, with silver and phosphate of lead (P.R. Vol. 7).

Wombat Creek; Dargo; Buchan; Snowy River (Cl.). Ararat; Dargo High Plains; Murray River (M.H.). Dry Gully, near Mount Livingstone (Stirling in Trs. R.S. S.A., 1883-4).

CERVANTITE. — Costerfield (M. 1866). Heathcote; Whroo; Anderson's Creek; Rutherglen; Maryborough, and other places (B.S. 1866). Bacchus Marsh (P. 1873). Comadai Creek, Ballan (P. 1878). Queenstown; Dunolly; Maldon (T.M.). Ringwood; Costerfield, with acicular crystals (M. 1870). Beechworth (P.R. Vol. 3). See also *Valentinite* and *Stiblite*.

CHABASITE.—Pentland Hills, in older basalt; near Clunes, in basalt; Malmsbury (M. 1866). Phillip Island, in older basalt; near Frankston, on granitite (P. 1868). Gippsland (P. 1880). Maldon (P. 1882-3). Yarragon, in coal (P. 1886). Flinders (T.M.). Beechworth (P.R. Vol. 3). Brunswick quarries (P.R. Vol. 6). Ballan (M.R.F.).

CHALCANTHITE (Blue Vitriol).—Thompson River Copper Mine, sparingly in thin seams and crystallizations (M. 1866). Bethanga; Ringwood (T.M.).

CHALCEDONY.—Near Keilor and Sunbury, coating cavities in basalt, tolerably frequent; Phillip Island, nodules and pebbles on the shore; Moroka Valley, Gippsland, as geodes; Spring Creek, Beechworth (M. 1866). Creeks of Beechworth district (Bl. 1866). Waratah Bay (P. 1878). Buchan (Cl.). Heathcote, near Police Camp; Phillip Island, sometimes with cavities containing yellow carbonate of lime, sometimes with empty cavities, sometimes with a vein of quartz running through it (N.M.). Chiltern; Wallace's Creek; Landsborough; Mitchell River; Richmond; Tarra Range; Turton's Creek; Waterhouse Island in Bass Strait; Bird Rock (P.R. Vol. 3). Near Berwick; Avoca (M.R.F.).

CHALCOCITE (Redruthite).—Thompson River Copper Mine, small veins and patches, scales and grains in copper pyrites; Steiglitz, impregnated in the rocks (M. 1866). Wombat Creek, Gippsland (Cl.). Livingstone Creek; Buchan; Snowy Creek; Snowy River; Nicholson

River; Murrindal River (B.S. 1872). Bendigo; Castlemaine (Sel. 1861). Cathcart (M.H.). Copper sulphides, without stating which sort, are recorded from Omeo (P. 1870). Maldon; Bruthen Creek; Broken River; North Gippsland (P. 1868). Beaufort; Beechworth; Blue Mountain; Bright; Crossover Creek; Heathcote (P.R. Vol. 3).

CHALCOPYRITE.—Thompson River Copper Mine, massive, in veins and patches; In most of the auriferous reefs at Castlemaine; Maldon; Steiglitz; Bendigo; Ballarat; St. Arnaud, etc. (M. 1866). Blue Mountain; Inglewood; Dunolly; Gippsland, etc. (B.S. 1866). Howqua River with galena (N.M.). Dargo High Plains (P. 1872). Gaffney's Creek; Dedduck, in quartz (P. 1873). Charlton (P. 1875-6). Bethanga, with carbonate of copper (P. 1877-8), Harcourt, on granite (P. 1882-3). Thomastown; Budgee, Gippsland; Yarrawonga (P.R. Vol. 7). Bruthen; Buchan; Deptford; Wombat Creek; Omeo (Cl.). Snowy Creek (P.R. Vol. 6). Majorca; Cathcart; Linton's (M.H.). Burke's Flat; Murrindal River (P.R. Vol. 3). Tongio West (M.R. 1896).

CHALK.—South-west corner of Victoria (Pr. R.S. Vic., 1891, p. 98).

CHALYBITE.—In some of the reefs at Maldon and St. Arnaud (M. 1866). Corinella, in coal shaft (N.M.). Hawthorn Creek, Tangil, earthy (P. 1884). Mirboo, impure; Fryerstown, coated with oxide of iron and pyrites (M.R. 1884). Jindivik (P. 1887). Mitta Mitta River; Ballarat (M.R. 1889). Daylesford (P. 1889). Warrenheip, concretionary (P. 1891). In satin-coloured masses with patches of manganese at Bruthen; Gelantipy; and Mount Taylor (Cl.). Barfold; South Clunes; Tourists' Creek (T.M.). Carbonate of iron is recorded from Beechworth; Buckland River; Gibbo River; Heathcote; Port Albert; Bendigo (P.R. Vol. 3). A carbonate of iron and manganese from Moe (P. 1880). Clay, iron ores from Avoca (P. 1874). See also *Sphærosiderite.*

CHERT.—Lancefield District, along the boundary of the diorite greenstone (M. 1866). Near Heathcote; Beechworth;

Murrindal ; near Melbourne (T.M.). Dandenong Ranges ; Kingower ; Mount Disappointment ; Upper Wannon Falls ; Bendigo (P.R. Vol. 3). Mount Useful (M.R.F.).

CHIASTOLITE.—See *Andalusite.*

CHLORIDE OF SILVER.—St. Arnaud (P. 1874). Gift Reef, Bethanga (P. 1877-8). Landsborough (P.R. Vol. 3).

CHLORITE.—Lady Gully Reef, and Wattle Flat, near Castlemaine ; Fryerstown ; near Yandoit, on the top of a high range (M. 1866). Long Gully, Bendigo (P. 1884). Mount Taylor, in porphyries (Cl.). Upper Loddon, coating imperfect quartz crystals (T.S.H.). Beechworth ; Chiltern, in granite (E. J. Dunn in Trs. R.S. Vic., 1874). Snowy River ; Talbot (P.R. Vol. 3). Near Heathcote, in diabase rocks (H. 1896). See *Leucoxine.*

CHLOROPAL (Hyd. Sil. of iron).—Sunbury, nodular masses, in decomposed basalt (N.M.). Deep Creek, in basalt ; Mount Bullangarook, in basalt (Sel. 1861). Maldon (P.R. Vol. 3).

CHROME OCHRE.—In several reefs at Heathcote ; Strathloddon, etc. (M. 1866). Pleasant Creek (M. 1870). Grampians, near Stawell (P. 1874). Buchan (Cl.). Beechworth ; Benalla ; Wangaratta (T.M.).

CHROMIC IRON.—Heathcote, in quartz reefs and quartzose rocks ; Heathcote Creek ; Argyle Gully, as fine black sand ; Strathloddon ; Riddell's Creek (M. 1866). Stockyard Creek, crystals (B.S. 1872). Franklin River, crystals ; Creek beds at Heathcote, crystals (P. 1871). Near Corner Inlet ; tributaries of Latrobe River, dull crystals (P. 1874). North Gippsland, massive (P. 1875-6). Bairnsdale, as sand (P. 1877-8). Mansfield (P.R. Vol. 7). Walhalla ; Stawell (T.M.) Beechworth ; Benalla ; Mount Macedon ; Mount Wellington (P.R. Vol. 3). Delatite River ; Howqua River ; Turton's Creek ; Snowy River (P.R. Vol. 4).

CHROMIUM.—Costerfield (P.R. Vol. 3).

CHRYSOCOLLA.—Bloomfield's Gully, Omeo, impure, in vein stuff (B.S. 1872). Snowy Creek (P.R. Vol. 3). Silicate of copper is recorded from Dry Creek, near Mount Livingston (Stirling, in Trs. R.S.S.A. Vol. 7, 1883-4).

Chrysolite.—See *Olivine.*

Chrysoprase.—Beechworth district (Bl. 1866). Woolshed Creek: Sebastopol (Bl. in Trs. R.S. Vic., 1865-6).

Chrysotile.—Mount Timbertop (P.R. Vol. 3).

Cinnabar.—See *Mercury.*

Clays.—Deep Creek, Bulla, from decomposition of granite (B.S. 1861). Dunolly; near Kyneton; other places (M. 1866). Lal Lal, bed three feet thick overlying lignite (N.M.). Preston; Boroondara; other places near Melbourne, suitable for bricks and pottery; Lilydale (B.S. 1872). Sutton Range (Grange? J.A.A.) (T.M.). Stawell, suitable for bricks (M.R. 1890). Morwell; Darlimeura, suitable for earthenware; Korkuperrimul, suitable for pottery; Boolara (M.R. 1889). Huntly, suitable for terra-cotta (M.S. 1885). Beaufort, suitable for Staffordshire ware; Jackson's Creek, near Sunbury, infusible clay; near Smeaton (P. 1870). Bendigo; Geelong (P. 1871). Nunawading, stands the fire well (P. 1872). Stawell; Hawthorn, suitable for bricks; Moorabool River, suitable for white ware (P. 1873). Moe; Western Port, suitable for bricks (P. 1874). Strangways, suitable for crockery; Fyansford; Lauriston, suitable for pottery; Daylesford, suitable for bricks and tiles; Gaffney's Creek, could be made into paint (P. 1876). Gippsland, suitable for bath-brick and fire-brick (P. 1879-80). Bethanga, fire-clay (P. 1882-3). Tarwin River, suitable for tiles, earthenware, and white bricks (P. 1883). Ringwood, fire-clay; Stawell, fire-clay; Malvern; Orrong Road, Prahran (P. 1884). Maldon; Epsom (P. 1885). Frankston (P. 1886). Yapeen (P. 1887). Rushworth (P. 1889). Foster, fire-clay (P. 1890). Ballan; Narracan Valley, fire-clay; Gordons, fire-clay (P. 1891). Redesdale (T.M.). Footscray; Western Port; Cape Patterson; Bass River; Bruthen Creek; Phillip Island; Wangaratta; Maryborough (P. 1868). Baringhup; Inglewood; Moe; Warburton; Woori Yaloak Creek; Upper Yarra; Brighton; Northcote (P.R. Vol. 3). See also *fullers' earth, lithomarge, halloysite,* and other varieties of *clay.*

CLAY IRON ORE.—See *chalybite* and *sphærosiderite.*

COAL, BROWN COAL, AND LIGNITE.—Special reports on the coal-fields of Victoria, containing very much useful information, are issued from time to time by the Mines Department. For a list of the principal localities see M.H., p. 34.

COBALT.—See *asbolite.*

COCCOLITE (var. of augite).—In basaltic rocks (Sel. 1861). Camperdown; Daylesford; Mount Franklin (P.R. Vol. 3).

COLOPHONITE (Wine-yellow garnet).—Ovens (Bl. in Trs. R.S Vic., 1865-6).

COLUMBITE.—Maldon (P.R. Vol. 3).

COMPTONITE.—See *Thomsonite.*

COPALINE.—Bass River, in lignite beds; Coal Creek, not *in situ* (N.M.).

COPIAPITE.—Near Point Addis, in tertiary beds (M. 1866). Spring Creek, near Geelong, probably results from the decomposition of iron pyrites (N.M.), analysis by Mr. R. Daintree in Catalogue of National Museum, Melbourne, 1868. Mornington (T.M.). Castlemaine (?), brownish crusts and stains on spoil and pyrites heaps (T.S.H.). Basic sulphate of iron is also recorded from Buninyong with iron-alum (T.M.). Angahook (B.S. 1872). See *Melanterite.*

COPPERAS.—See *Melanterite.*

COPPER (native).—Thompson River, rounded pieces in the wash; Thompson River Copper Mine; Wilson's Reef, St. Arnaud; Specimen Gully, Castlemaine, thin small scales; Steiglitz; Louisa Ranges, Crooked River (M. 1866). Rodney Mine, near Ballarat, filamentous; Malmsbury, basalt quarries, small grains in sphærosiderite (B.S. 1872). Thompson River, with moss copper (N.M.). Clunes, in tertiary drifts (M. 1870). Sebastopol and Egerton, thin strings and arborescent forms in silurian shales (P. 1870), see note by Mr. J. C. Newbery in the same volume. Bethanga, in quartz; Richmond, specks on basalt (P. 1877-8). Stawell; Blackwood; Ballarat, in bed-rock under the deep leads

(P. 1871). Footscray, a mass several pounds weight in a basalt quarry (P. 1873). Creswick; Mitta Mitta; Cooper's Creek (M.H.). Avoca, deep lead; Beechworth; Landsborough (P.R. Vol. 3). Magpie, near Ballarat, small specks throughout the quartz (Pd.). *Copper ores*, without naming which kind, are recorded from between Snowy River and Bendoc; Granite Flat, Snowy River (P. 1871). County Millewa; Spring Creek, near Buchan (P. 1884). You Yangs (P.R. Vol. 7). On a branch of the Wentworth River (Cl.). Costerfield and Heathcote, antimonial; Beaufort; Bonang; Bright; Mount Wellington (P.R. Vol. 3).

Corundum (black).—Nearly all our gold fields, in semi-angular or rounded pieces (M. 1866). Colac (P. 1871). Phillip Island, in older basalt (P. 1877-8). Analysis in Catalogue National Museum, Melbourne, 1868; Daylesford; Benalla; Mount Blackwood (T.M.). Mansfield; Dandenong (P.R. Vol. 3).

Covelline.—Steiglitz and Dunolly, in the reefs; Specimen Gully Reef, Castlemaine; Glen Dhu Reef, Landsborough; Crooked River, thin scaly coatings (M. 1866). Scotchman's Gully Reef, Castlemaine; Harcourt, coating chalcopyrite (T.S.H.). Bendigo (Sel. 1861). Maldon (T.M.). See note to *Chalcocite*.

Cuprite.—Thompson River Copper Mine (M. 1866). Steiglitz (Sel. 1861). Bethanga (P.R. Vol. 6).

Cuproplumbite.—Costerfield antimony reef, small, scale-like crystals, very rare (M. 1866). McIvor (Sel. 1861).

Damourite.—"A mineral whose characters accord well with damourite was found in crystals of cairngorm at Bradford Lead, Maldon" (M. 1870). See *muscovite*.

Darlingite (species of lydianite).—Ovens district (Bl. in Trs. R.S. Vic. 1866).

Diallogite.—Port Phillip Company's Mine, Clunes, in crevices and cavities of the reefs, forming crusts over quartz and psilomelane (M. 1866). See *Rhodochrosite*.

Diatomaceous earth.—See Infusorial earth.

Diamond.—In the creeks of the Beechworth district, from $\frac{1}{8}$ to $2\frac{1}{2}$ carats (M. 1866). One of 17·64 carats was reported

in 1864 (B.S. 1866). North-East Gippsland? (Bl. 1866). Near Bendigo? (P. 1870). Mansfield (P.R. Vol. 3). Toombullup, 25 miles from Benalla ("Argus," 5th May, 1896).

DITTMARITE.—Skipton Caves, a mineral new to science was recorded under this name by Mr. McIvor, in "Chemical News," 13th May, 1889.

DOLOMITE.—Maldon, drusy coatings in joints of metamorphic sandstone; Howqua district, massive in some reefs (M. 1866). Broadmeadows, with brown hematite, under the basalt (M. 1870). For analysis see M. 1870. Near Ballan (N.M.). Ajax and Wattle Gully reefs, Castlemaine; a white, earthy soft substance, consisting of carbonates of lime and magnesia, at Barker's Creek quarries: Castlemaine, a magnesian-lime cement in some of the old gravels (T.S.H.). Maldon, with calcite, vivianite, apatite, scheelite, etc. (P 1875-6). Phillip Island, in older basalt, pseudomorphs after aragonite; Mansfield (P. 1877-8). Waratah Bay (P. 1878). Toongabbie (P. 1882-3). Geelong (P. 1885). Daylesford (P. 1889). Ballarat (M.R. 1889). Bendigo (P. 1888). Gaffney's Creek; Buchan; Walhalla (T.M.). Woods Point; Beechworth; Clunes; Harrow; Mount Timbertop (P.R. Vol. 3). Loyola (P.R. Vol. 4). *Blue dolomite* at Woodford (Bradford? J.A.A.), Victoria, on vitreous quartz (G.S. N.S.W. Vol. 4, p. 141). Maldon (P. 1875-6). See also *Brown Spar.*

ELECTRUM.—Swift's Creek, Omeo (Cl.).

EMBOLITE.—The silver mines at St. Arnaud, in cracks and cavities of the quartz (M. 1866).

ENHYDROS.—Beechworth (P. 1875-6). Read the following papers on enhydros:—A. Liversidge, in R.A.M.S Vol. 2, No. 3, p. 35; T. Cooksey, in R.A.M.S. Vol. 2, No. 6, p. 92; E. J. Dunn, in Trs. R.S. Vic., 1874; and G. Foord, in the same volume.

ENSTATITE.—Buchan, in diabase rock (Howitt in Trs. R.S. Vic., Vol. 18). Heathcote, in diabase rock (Catalogue T.M. 1894, p. 33).

Epidote.—Nuggetty Gully, Talbot, with quartz and flesh-coloured orthoclase; south-east of Tarilta, dense crystalline rock, rare form (M. 1870). Analysis in the same book. Near Buchan (M.R. 1889). Dividing Range, Gippsland; Omeo Road, Gippsland, vein in syenite (T.M.). Snowy River; Dry Hills, Gippsland (P.R. Vol. 3). Near Heathcote, in granite, and in altered diabase rocks (H. 1896). Snowy Bluff (M.R.F.).

Epsomite.—In tertiary, mesozoic, and silurian rocks near Geelong; Bacchus Marsh; Cape Otway, etc.; Snow-flake efflorescences in quartz reefs as at Clunes; Maldon, etc. (M. 1866). Argus Hill Mine, near Castlemaine, thick incrustation in old drives (T.S.H.). Bendigo; Growler's Creek Ranges; Stawell (P.R. Vol. 3).

Erubescite.—See *Bornite*.

Erythrite.—Dargo, peach-coloured crystals in quartz (Cl.).

Essonite (Cinnamon Stone).—Ovens (Trs. R.S. Vic., 1866).

Fahlerz.—See *Tetrahedrite*.

Felspar.—No species named. Swift's Creek, in a dyke (M.S. 1884). Lal Lal (P. 1885). Beechworth (M.R. 1889). Glassy felspar, Daylesford, in basalt (M.S. 1887). See also *orthoclase*, *oligoclase*, *labradorite*, and other species of felspar.

Ferro-calcite.—Barfold Falls, Campaspe River, in basalt, (M. 1866). Saltwater River; Mitchell's Falls (N.M.). Analysis in Catalogue (N.M. 1868). Collingwood (Trs. R.S. Vic., Vol. 16, 1880, p. 144).

Fibrolite.—Moroka Valley, Gippsland; near Beechworth, in granite (M. 1870). Dandenong Ranges; Northern Gippsland (B.S. 1872). Crooked River (Cl.). Swift's Creek (P. 1878). Geelong; Gippsland; Yackandandah (T.M.). Dargo River (P.R. Vol. 3). For analysis see P. 1872.

Flint.—Cape Otway coast; Warrnambool coast; Phillip Island (N.M.) Near Dandenong (M. 1870). Portland Bay; Flinders; Emerald diggings; Bed of Yarra (T.M.), Griffith's Point (P.R. Vol. 3).

Flos-ferri.—Richmond quarries, lining cavities in basalt (N.M.).

FLUOR-SPAR.—Near Beechworth, crystals in narrow veins and small patches in brecciated dyke (M. 1870). Eaglehawk Reef, Maldon (P. 1880-1). Chiltern, in granite; Beechworth, in granite (T.M.).

FOSSIL-WOOD.—See *silicified wood.*

FRANKLINITE.—Tambo River and Nicholson River, in black sand (Cl.).

FULLER'S EARTH.—Clifton Springs, near Drysdale, a large deposit (B.S. 1872). Redesdale, seams of silicate of alumina and magnesia under stiff clay, might be used as fuller's earth (N.M.). Lilydale (B.S. 1872).

GALENA.—Steiglitz; Castlemaine; Bendigo; Maryborough, in quartz reefs (Sel. 1861). Wilson's Reef and Silver Reef, St. Arnaud, veins and patches; impregnated in most, perhaps all, auriferous quartz reefs (M. 1866). In the mineral veins throughout the colony (B.S. 1866). Dargo High Plains, with cerussite, chalcopyrite, etc.; Dedduck River; Snowy River; Chinaman's Flat, Maryborough, alloy of lead and gold; Eastern Gippsland, auriferous (B.S. 1872). Scotchman's Gully, Castlemaine, in grains (T.S.H.). Wombat Creek, crystals and massive; Buchan, crystals and granular; Swift's Creek; Haunted Stream; Dargo (Cl.). Rushworth (P.R Vol. 7). Moyston; Pleasant Creek; Morse's Creek; Yackandandah; Maldon; Glen Dhu (P. 1868). Landsborough, argentiferous; Blackwood; Linton's, said to be near a bismuth reef (P. 1870). Near Percydale (P. 1871). Buchan and Corner Inlet, antimonial; Dargo River (P. 1872). Murrindal, antimonial; Back Creek (P. 1873). Maldon (P. 1874). Harrietville, with cerussite; Stockyard Creek (P. 1876). Bethanga, argentiferous (P. 1878). Champion Bay (P. 1879-80). Bendoc (P. 1884). You Yangs; Zulu Creek (M.R. 1889). Ararat; Avoca; Beechworth; Berlin; Chiltern; Crooked River; Gordons; Kingower; Mount Useful; Omeo; Stawell; Tarnagulla; Murrindal River; Corner Inlet (M.H.). Blue Mountain; Daylesford; Dunolly; Gibbo River; Pyrenees; Reedy Creek; Anderson's Creek; Donovan's Creek; Kilmore; Bendigo;

Snowy Creek; Sunbury; Thirty-mile Creek; Costerfield, antimonial (P.R. Vol. 3). Casterton, argentiferous; Buchan, argentiferous (M.R. 1896).

Garnet.—Reid's Creek; Woolshed; Sebastopol; Eldorado; in the gold-drifts; Longwood, in diorite dyke; Lady Franklin Mountain, in euritic dyke; Barnawartha Creek (M. 1866). Near Lilydale; head of Woori Yaloak Creek (B.S. 1872). Eaglehawk Reef, Maldon, in a diallage dyke (J. Hornsby, teste T.S.H.). Maldon, in granite (J. Dennant, teste T.S.H.). Harcourt, in granite (T.S.H.). Livingstone Creek; Mount Taylor; Creeks of Eastern Gippsland from Mount Taylor, with menaccanite (Cl.). Bradford Lead, Maldon, in quartz; Hill's Corner, Baynton (N.M.) North-east of Berwick, in the creeks; Mount Timbertop (M. 1870). Barker's Creek, Castlemaine, in a mica-schistlike rock, in the gold-drift (M. 1866). Blackwood; Dry Creek; near Mansfield; Ballarat (P. 1870). Bethanga (P. 1881). Corner Inlet (P. 1876). Mount Buller (P. 1877-8). Swift's Creek, in granite (P. 1878). Buxton (M.R. 1889). Benalla, crystals of green garnet in felspathic rock (P. 1874). Chiltern; Euroa; Mount Korong; Rockpoint; Alexandra; Kingower; Lilydale; Longwood; Sassafras Creek (P.R. Vol. 3). Howqua River (P.R. Vol. 4). See also *Essonite*, *Pyrope*, *Colophonite*, etc. "The Victorian garnets seem all to be almandine" (Bl. 1866).

Glauconite.—Bruthen (Cl.). Snowy River Bluff (H., teste Cl.). Spring Creek, south of Geelong (G. B. Pritchard in "Remarks on the Tertiaries of Australia," South Australian School of Mines). Green earth forms a constituent of some of the basalts (Catalogue T.M. 1894, p. 44).

Gmelinite.—Phillip Island, in basalt (M. 1866) Richmond, in basalt (Sel. 1861). Flinders (T.M.).

Gold.—For a list of localities, and for modes of occurrence, see the following works, which furnish full particulars:—"Goldfields of Victoria," by R. Brough Symth. Essay on "Mining and Mineral Statistics of Victoria," in the

Official Record of the Intercolonial Exhibition, Melbourne, 1866. "Miners' Handbook," issued by the Mines Department, Melbourne. A tabular record of the most remarkable specimens will be found in the Catalogue of the Victorian Exhibition, 1861, and lists of other specimens, found since that date, are in the "Progress Reports" of the Geological Survey. A list of nuggets and large masses of gold found *in situ* in reefs, by W. Nicholas, is in the Report and Statistics of the Mining Department for the quarter ending 30th September, 1890, pp. 24-27.

GRAMMATITE.—Eaglehawk Reef, Maldon (T.M.). See *tremolite*.

GRAPHITE.—Ovens gold fields (Sel. 1861). Blackwood (?); Reefs of St. Arnaud and Mount Pleasant districts, shaly substance impregnated with carbonaceous matter, in lumps and casings; Golden Point Gutter, Ballarat, true graphite, inferior quality (M. 1866). Beechworth (Bl. in Trs. R.S. Vic. 1866). For report by Mr. J. C. Newbery on sample from Ballarat, see M.S. 1875-6. Omeo (M.S. 1885). Mallee (P.R. Vol. 7). Mount Wills (Cl.). Castlemaine district, impure, coating slates in vicinity of quartz reefs (T.S.H.). Daylesford (T.M.). Upper Murray (P.R. Vol. 3). Dargo, in dyke rock (H. in Trs. R.S. Vic., 1887).

GUANO.—Caves at Cape Otway (P. 1876). For analysis by Mr. Newbery see M.S. 1876. Skipton Caves; Hamilton; Portland; Warrnambool ("Chem. News," 13th May, 1887).

GUMBELITE (?). — Castlemaine district, replacing graptolites (T.S.H.).

GYPSUM.—Abundant in thin veins, patches, and concretionary masses in the tertiary sandstones and clays along the coast from Jan Juc to Point Addis; Cape Otway district; tertiary beds all over the Murray basin; in the saline deposits of lakes and lagoons; raised beaches and swamps near the sea, as Batman's Swamp; Mount Consultation, Castlemaine, in clays overlying the gravels; Sandy Creek, Tarrengower; Ballarat deep leads; in the Western district and in the banks of the Murray River

casts of shells occur consisting of selenite (M. 1866). Mornington, in blue clay; Spring Plains, in bluish surface clay (M. 1870). Daylesford (B.S. 1872). Lake Tyers (P. 1876). Kerang (P. 1878). Geelong (P. 1879-80). Carisbrook (P. 1882-3). Lake Hindmarsh (M.S. 1885). Elwood Swamp, St. Kilda (P. 1889). Lake Boga (M.R. 1890). Mount Emu Creek (T.M.). Maryborough (P.R. Vol. 7). Barwon Heads; Korong; Queenscliff; Collingwood basalt quarries; near Portland (T.M.). Alexandra; Bacchus Marsh; Beechworth; Growler's Creek; Inglewood; Lake Connewarre; Moonee Ponds; Salt Lakes; St. Arnaud; Stawell; Bendigo (P.R. Vol. 3). Korong district (M.R.F.).

HALITE.—See *Common Salt.*

HALLOYSITE.—The partly-decomposed basalts and the clays of the gold-drifts, and the fossiliferous tertiaries around the coast generally, contain nodules of amorphous silicates, some of them resembling halloysite (M. 1866). Star Hill, Woods Point, in quartz veins; Energetic Reef, Lauriston; Alexandra, in quartz reefs (M. 1870). Crossover, Gippsland (P. 1880). Beechworth; North Melbourne, from older basalt; Wandin Yaloak (T.M.). Western Port Bay, a mineral resembling halloysite (Catalogue T.M., 1894).

HANNAYITE.—Skipton Caves and near Warrnambool, in guano deposits (Chem. News, 13th May, 1887). For analysis, see the same journal.

HEMATITE.—Stony Creek, Western Port; Bennison's Flat (P. 1874). Wilson's Promontory (M.S. 1875-6). Snowy River (P. 1876). Mount Willi, Gippsland (P. 1888). Mansfield (M.R. 1889). Gippsland (T.M.). Nowa Nowa; Mount Taylor; Livingstone Creek (Cl.). Dargo, in dyke rock (H. in Trs. R.S. Vic., 1887). *Red oxide* of iron is recorded from Bald Hills; Brighton; Bruthen Creek; Campaspe River; Cape Roadknight; Colac; Godfrey's Creek; Mac's Creek; McDonald's track; Pearl Point; Woods Point; Plenty River; Ringwood; Snowy Creek; Swan Island; Bonang (P.R. Vol. 3). See also *specular iron* and *red ochre.*

HERSCHELLITE.—Richmond basalt quarries, double hexagonal pyramids, or druses, or macles, or groups (N.M.) For analysis see M. 1870. See also Mr. Newbery's report in Catalogue T.M. 1894. Clunes (P.R. Vol. 3).

HETEROSITE (phosphate of iron and manganese).—Mount Wills (T.M.).

HEULANDITE.—Tiverton Reef, Maldon, drusy coatings in joints of the quartz (M. 1870). Lisle's Reef and Lennon's Reef, Tarrengower, in crevices and joints of metamorphic sandstone (M. 1866). All the specimens examined show tabular crystals of heavy spar (M. 1870). Phillip Island, in older basalt; Frankston, on granite (P. 1877-8).

HORNBLENDE.—Anakies, crystals in scoriaceous basalt; Castlemaine, in basic dyke; Mount Alexander; Lancefield; McIvor, etc., in granite (M. 1866). Beechworth, in the tin sands (B.S. 1866). Fiddler's Reef, Forest Creek (N.M.). Phillip Island, in older basalt; Eaglehawk Reef, Maldon (P. 1877-8). Camperdown; Gippsland (T.M.). Howqua River; Jameson (M.R. 1884). Dargo, in igneous rocks (H. in Trs. R.S. Vic., 1887). Wattle Gully; Burn's Reef, in basic dykes; Eaglehawk Reef, Maldon, a green variety (T.S.H.). Mount Franklin (P.R. Vol. 3). Mount Buller (P.R. Vol. 4). For analysis of the Anakies specimen see Catalogue N.M., 1868. Near Heathcote, in granite, diorite, and diabase rocks (H. 1896).

HORNSTONE.—See *Chert.*

HYACINTH.—Ballarat; near Daylesford; Crooked River; abundant on nearly all the gold-fields (Bl. 1866). Dandenong; Campaspe River near Redesdale, in black sand in the drift resting on basalt (N.M.). See *Zircon.*

HYALITE.—Cavities in basalt of various localities (Sel. 1861). Malmsbury; Kyneton; Gisborne; Baringhup, etc., drop-like incrustations in basalt cavities (M. 1866). Kilmore, coating basalt (N.M.). Moe (P. 1880). Collingwood (P. 1889). Gelantipy; Omeo; Mitchell River (Cl.). Near Geelong; Mount Hepburn; basalt cavities at Learmonth (T.M.). Beechworth; Magnet

Hill, Baynton's; Mount Franklin; Redesdale; Stawell (P.R. Vol. 3).

Hydrate of Alumina.—Coleraine (P.R. Vol. 4). Analysis on page 163 of same volume.

Hydromagnesite.—Collingwood basalt quarries (T.M.).

Hydrophane.—Stawell (P.R. Vol. 3).

Ilmenite.—Yarra basin, with stream tin (Bl. 1866). Near Castlemaine, as black sand in the alluvial deposits draining from the basalt (T.S.H.). Near Heathcote, in diabase rocks (H. 1896). See *titaniferous iron.*

Infusorial Earth.—(Tripolite, Randanite, Diatomaceous earth). Talbot, found in all stages, from the pure, soft, snow-white silica containing the well-known infusorial forms, to masses resembling opal and chalcedony (P. 1873). For analysis see P. 1872 and M.S. 1875-6. West Melbourne Swamp, impure, clayey (P. 1878). Middle Creek, Radborough (P. 1884). Brunswick (P. 1885). Lillicur (M.S. 1885). Maryborough (M.S. 1886). Gippsland (M.R. 1886). Campaspe River, near Redesdale, in clay in the gold-drift; Lancefield; Sebastopol; Amherst (T.M.). Alexandra; Daylesford (P.R. Vol. 3). See paper by F. M. Krausé in Trs. R.S. Vic., 1887.

Iolite.—Traawool, grains and crystals in granite; Maldon, in pegmatite (T.M.).

Iridosmine.—Reported from Yarra goldfields, fine steel-grey particles in "heavy sand" (M. 1866).

Iron (native).—Western Port district, with nickel, in masses (B.S. 1861). Two large masses, one of half a ton, and the other about four tons in weight, and several smaller pieces were found in the neighbourhood of Cranbourne (M. 1866). Langwarrin, near Frankston (P. 1887). Smythesdale (P.R. Vol. 7). Near Daylesford (M.R. 1889). In the basalts of Ballarat (Liversidge, in Minerals of New South Wales).

Iron ores.—Iron ores, without naming the species, are recorded from Castlemaine and Bendigo (B.S. 1861). Thompson River (P. 1878). Near Bairnsdale (P. 1881). Goodman's Creek; Jan Juc (M.S. 1884). Grantville (M.S. 1885). Grampians (M.S. 1886). Ironstone is recorded

from Glassy Creek, Western Port (P. 1878). Brighton Beach (P. 1880). Mount Egerton; Otway Forest; Junction of Bendigo Creek and Back Creek (P. 1877-8). Clayey and arenaceous ironstone occurs at Avoca; Ballarat; Buninyong; Campaspe River; Cape Road-knight; Eddington; Frankston; Guildford; Little River; Loddon Valley; Malmsbury; Mooroolbark River; Mordialloc; Murray River; Bendigo; St. Arnaud; Steiglitz; Sunbury; Traralgon; Werribee River (P.R. Vol. 3). Much information on the occurrence of iron ores will be found in M.H. See *limonite*, etc.

Iserine.—"Generally distributed" (Sel. 1861). See *titaniferous iron*.

Jamesonite.—Maldon, bunches of crystals with molybdenum in quartz, a considerable distance from the antimony deposits (P. 1878). Buchan, argentiferous (P. 1883). Dargo; Murrindal (Cl.).

Jargon.—See *Zircon*.

Jasper.—Cape Otway Coast, near Gellibrand River, common as pebbles; in drifts of Yarra basin and at Beechworth (M. 1866). Common along the western sea coast and in some of the drifts; Moroka Valley (N.M.). Tarwin River (P. 1878). Briagolong; Mansfield (P. 1887). Buchan; Goulburn River; Koroit Creek; Murrindal; Malmsbury; banded variety at Beechworth (T.M.). Lake Tyers; Snowy River; Tarra Range; Swan Island (P.R. Vol. 3). Opal jasper from the basalt at Riddell's Creek; Sunbury; Gelantipy; Bullengarook (N.M.). For description of Sunbury specimens see N.M. Near Melbourne, in basalt (Sel. 1861).

Jet.—Lal Lal (P.R. Vol. 3).

Kaolin.—See *Clays*.

Kermesite.—Morning Star Reef, Woods Point, in powdery coatings and crystals, very rare (M. 1866). Ringwood (T.M.).

Labradorite.—Malmsbury, in porphyritic dolerite; Table Hill, near Guildford; Loddon basaltic outliers generally (M. 1866). Barrabool Hills (P.R. Vol. 3). In all our labradorite rocks, diabase and gabbro (Catalogue T.M.,

p. 32). In nearly all our newer and older basalts (Catalogue T.M., pp. 34 and 40). Near Heathcote, in diabase rocks (H. 1896).

LAMPADITE.—Wombat Creek, black earthy masses (Cl.).

LEAD AND GOLD ALLOY.—Landsborough; Maryborough (P.R. Vol. 3).

LEAD (native).—Mount Greenock, in drifts; Avoca, in deep lead, small quantities (M. 1866). Talbot, in the auriferous tertiaries (B.S. 1866). Anderson's Creek, in quartz; Linton's, with copper and zinc (P.R. Vol. 7). Majorca (P.R. Vol. 3).

LEAD OCHRE.—Majorca (P.R. Vol. 3).

LEDERERITE.—Richmond, in basalt (Sel. 1861). See *Gmelinite.*

LEUCOPYRITE.—Deptford; Mount Baldhead; Dargo; Omeo; Wombat Creek (Cl.).

LEUCOXINE.—Near Heathcote, in diabase rocks (H. 1896).

LIGNITE.—See note under *Coal.*

LIMONITE.—Veins and concretions in the silurian rocks of all the gold-fields generally; in the tertiary rocks round the sea coast; in veins of quartz reefs; as a cement in auriferous conglomerates; Bacchus Marsh; Lake Connewarre; Batman's Swamp; basaltic plain and hill slopes of the Loddon Valley, pea-like, or shot-like; margin of the Murray basin; valleys of Werribee, Loddon, Little, and Campaspe Rivers (M. 1866). St. Arnaud (B.S. 1866). Wattle Gully, pseudomorphs after pyrites; Bolivia Hill, iridescent film on rocks (T.S.H.). Nicholson River; Clifton Creek; Boggy Creek; Bairnsdale; Buchan; Omeo (Cl.). Pascoe Vale; near Lancefield; Home Creek; Queensferry; Western Port; South Muckleford (N.M.). Moonee Ponds; Mordialloc; Bruthen Creek (P. 1868). Lal Lal; wherever decomposed basalt exists; Seymour; Steiglitz (P. 1873). Bendigo; Sebastopol; Crossover Creek; Stockyard Creek; Barwon River and Heads (P. 1874). Near Newstead, lode 150 feet wide; Daylesford; Traralgon; Lake Tyers; Wilson's Promontory (M.S. 1875-6). Snowy River; Whisky Creek; Fryer's Creek; north-east of Victoria; Blackwood; Dande-

nong; Strath Creek (P. 1878). Near Glenmaggie (P. 1880-1). Colac (P. 1880). Creswick (P. 1881). Granya; Yarrawonga (P. 1882-3). Near Queenstown (P. 1884). Jan Juc (P. 1885). Wombat Creek (P. 1886). Mount Bulla (P. 1889). Byaduc; Western District; Alexandria (M.S. 1885). Heathcote (M.S. 1886). Omeo, iridescent (M.S. 1887). Bulla Bulla (T. M.). Mansfield; Myrtleford; Warracknabeal; Nagambie; Merton; Neereman; Barrabool; Gembrook; Warrnambool; Murroon; Puebla, iridescent; Drouin (M.R. 1889). *Yellow ochre* from Snowy Creek; Blackwood; Anderson's Inlet; Tarwin River; Bacchus Marsh; Maldon (P. 1874). Gaffney's Creek (P.R. Vol. 4). *Oxide of iron* from South Wandin (M.S. 1887). Rushworth; Howqua; Darlingford; Molesworth (P.R. Vol. 7). *Brown iron ore* from Axedale; Ballarat; Beechworth; Benalla; Beauman's Flat; Berwick; Charlton; Clunes; Coal Creek; Coleraine; Frankston; Geelong; Goulburn River; Grampians; Huntly; Indigo; Lake Lonsdale; Lintons; Malmsbury; McIntyre's diggings; Royal Park, Melbourne; Saltwater River; Mount Black; Mount William; Myer's Creek; Porcupine Flat; Swan Island; Tarwin River; Wahgunyah; Warrandyte; Tarra Range (P.R. Vol. 3). See *iron ores.*

LITHOMARGE.—Beechworth (B.S. 1872). Anderson's Creek; Mirboo (P.R. Vol. 7). Stawell (P.R. Vol. 3).

LOLLINGITE.—Nuggety Reef, Maldon (P.R. Vol. 3).

LYDIANSTONE, LYDIANITE, LYDITE.—See *Basanite.*

MAGNESITE.—Bulla Bulla, in Kaolin deposits; Heathcote; near Geelong, in tertiary clays; Bacchus Marsh; Western Port and other places; banks of Loddon River, near Newstead, pure; Hard Hills, near junction of Loddon River and Jim Crow Creek; near Heathcote, in a vein with Selwynite (N.M.). Many places in the Bendigo district (P. 1871). Strangways and other places where Kaolin occurs (B.S. 1872). Steiglitz and Fryerstown, with Kaolin (P. 1874). Collingwood quarries (P. 1880). Tarnagulla (P. 1885). Campbell's

Creek; Castlemaine; Beechworth (P. 1886). Rushworth; Glenroy, in basalt (P. 1889). Charlotte Plains; Baynton; Dunolly; Majorca; Richmond; Gippsland (T.M.). Kampf's Gully, Castlemaine (T.S.H.) Maldon (J. Hornsby, teste T.S.H.). Stawell (P.R. Vol. 3). Magnesium carbonate near Heathcote, in diabase rocks (H. 1896).

MAGNETITE.—In the washing stuff of the gold-drifts, abundant, grains and crystals (M. 1866). Horse Hill, in drift from basalt; Baynton, near Maldon, octahedra in basalt, exhibits polarity (N.M.). Near Daylesford; Ballarat; Buchan (M.R. 1889). Nowa Nowa (Cl.). Dargo, in basalt (H., teste Cl.). Castlemaine, in deposits draining from basalt (T.S.H.). *Magnetic iron sand* from Yarra basin (N.M.). Beechworth; Gippsland (P. 1870). Gisborne; Lockwood; Kangaroo Flat; Flemington; many creeks in the colony (P. 1872). Tarwin Creek (P. 1873). Mansfield (M.S. 1875-6). Bruthen (P. 1884). Crossover Creek; Western branch of Yarra River (M.S. 1884). Bonang; Brighton; Campaspe River; Cudgewa Creek; Colac; Dandenong; Dargo High Plain; Koetong; Snowy Creek; Stony Creek; Tarra Tarra (M.H.). Bendigo (P.R. Vol 3). Near Heathcote, in granite and diabase rocks (H. 1896).

MALACHITE.—Thompson River Copper Mine; Steiglitz and Penrith Creek, in cavities of the reefs; St. Arnaud, in the silver reefs; Landsborough; Nicholson Reef, Castlemaine (M. 1866). Blue Mountain; Bendigo; Inglewood; Dunolly; Gippsland (B.S. 1866). Dedduck, in quartz vein; Crooked River (P. 1873). Between Koetong and Bright; Granite Flat; Snowy Creek, in quartz (M.S. 1875-6). Snowy River; Percydale (M.S. 1886). Mount Korong (T.M.). Dargo; Buchan (C.L.). Scotchman's Gully, near Castlemaine, small earthy patches (T.S.H.). Bethanga (M.H.).

MALDONITE.—Nuggetty Reef, Maldon (M. 1870). Eaglehawk Reef, Maldon, in the quartz lodes (M.S. 1875-6). For description see M. 1870.

MANGANESE.—Violet Town, in quartz; Sunday Creek (P.R. Vol. 7). *Manganese oxides*, without stating which kind, are recorded from Bairnsdale (P. 1872). Merton; Yea; Alexandra; Ararat; (P. 1868). Golton Golton, in the Grampians (P. 1874). *Manganese ores* from St. Arnaud, with silver ores (B.S. 1866). Clunes; many parts of the colony (P. 1871). Avoca, with tourmaline and quartz (P. 1876). See Mr. Newbery's report in the same volume. Costerfield (P. 1878). Jan Juc; Wallan; Eltham (P. 1885). Sale (M.R. 1887). Molesworth; Walhalla; Mansfield (M.R. 1890). Little Yarra River; Acheron River (P.R. Vol. 7). Kangaroo Ground, a vein eighteen inches thick (P. 1884). Mount Brown (M.R. 1889). *Manganese conglomerate* from Majorca (T.M.). *Black manganese ore* from Beaufort; Benalla; Cathcart; Chiltern; Daylesford; Godfrey's Creek; Griffith's Point; Linton's; Mitchell River; Mount Useful; Plenty River; Bendigo; Seymour; Skipton; Strangways; Stawell; Sunbury; Talbot; Lower Tangil; Tarilta; Tarra Range; Wandilligong; Warrandyte (P.R. Vol. 3).

MANGANITE.—Mount Taylor, Gippsland (Cl.).

MARCASITE.—Generally distributed (Sel. 1861). Woodside, Gippsland (P.R. Vol. 7). Omeo; Wombat Creek, Gippsland (Cl.). Lorne (T.M.).

MEERSCHAUM.—See *Allophane*.

MELACONITE.—Thompson River Copper Mine (M. 1866). Wombat Creek, Gippsland (Cl.). Bethanga (M.H.). Beechworth; Upper Murray (P.R. Vol. 3).

MELANTERITE.—Beehive Reef, Maldon, crystals (M. 1866). Briagolong (P. 1887). Ringwood (T.M.). Durham Lead; Leigh River, efflorescence on lignite (N.M.). *Sulphate of iron* from Cape Roadknight; Daylesford; Point Addis (P.R. Vol. 3).

MENACCANITE.—In the gold-drifts of perhaps all our gold fields (M. 1866). Creeks flowing from Mount Taylor; alluvial beds of Tambo and Nicholson Rivers (Cl.). Yarra River (T.M.). See *titaniferous iron*.

MERCURY.—Swamp Creek, a tributary of the Wentworth River, Gippsland, in alluvial (Jorgensen, teste Cl.). The "Age," 12th March, 1895, reported the finding of cinnabar and free mercury in considerable quantities at Jameson River. The "Argus," 21st January, 1896, reported ores of mercury in the neighbourhood of Beaconsfield.

MESITITE (carbonate of iron and magnesia).—Bendigo (T.M.).

MESOLITE.—Clunes, in basalt from a shaft, with calcite, etc. (M. 1870). Richmond quarries (P. 1877-8). South Clunes (P. 1879-80). Near Melbourne; Collingwood (T.M.). Preston Vale (P.R. Vol. 3).

MESOTYPE.—See *Natrolite*.

MICA (no species named).—Loddon Plain; Muckleford Creek; Castlemaine; Bendigo; Stawell (T.M.). Near Harrow; Glenelg; various localities (Sel. 1861). Bethanga (P. 1889). Phillip Island in older basalt (P. 1877-8). Inglewood (P. 1891). Dargo, in dyke rock (H. in Trs. R.S. Vic., 1887). *Green mica*, Beechworth, in granite (Trs. R.S. Vic., 1874). *Colourless mica*, near Heathcote, in granite (H. 1896). See *biotite and muscovite*.

MICACEOUS IRON.—Grampians, in veins of metamorphic rocks; Lake Tyers; other places in Gippsland (M. 1866). Northern parts of the colony (B.S. 1872). Boggy Creek (P.R. Vol. 7). Dunolly; Snowy River; Loddon River; Flemington (P. 1873). Dargo River; Nowa Nowa; Fernbank (M.R. 1889). Omeo; Dookie; Mitchell River (M.H.). Bairnsdale; Beechworth; Snowy Creek; Twofold Bay (P.R. Vol. 3). See *hematite* and *specular iron*.

MICROCLINE.—Dargo, specks in aplite (H. in Trs. R.S. Vic., 1887, p. 136).

MIDDLETONITE.—See *mineral resin*.

MIMETESITE.—St. Arnaud, in the silver reefs (M. 1866). In the mineral veins throughout the colony (B.S. 1866). Corner Inlet (M.H.).

MINERAL CHARCOAL.—South Clunes (P. 1879-80). Durham Lead, Ballarat, at the junction of a basaltic lava and overlying the gold-drift (T.M.).

MINERAL RESIN.—Two kinds occur in the Lal Lal lignite deposits, one resembling middletonite, and the other resembling retinite from the Bovey coal. Another occurs at Cape Patterson (M. 1866).

MIRABILITE.—Efflorescences on the walls of Prospector's Tunnel at Mitchell's diggings, Campaspe River (N.M.). (Geo. Sur. $\frac{1}{4}$ Sheet 13 S.E.). Stawell (P.R. Vol. 3).

MISPICKEL.—Generally distributed (Sel. 1861). Except pyrites, the most frequent ore in auriferous reefs; occurs in veins, patches, or impregnated; crystals in the slate and sandstone walls; Whip Reef, Bendigo; Lisle's and Manton's Reefs, Tarrengower; Wilson's Reef, St. Arnaud; Nimrod and Wattle Gully Reefs, Castlemaine, etc. (M. 1866). Barfold Ranges, with scorodite in quartz (N.M.). St. Arnaud; Glen Dhu (P. 1868). Maldon; Blackwood; Omeo; Donnelly's Creek; Bright; Landsborough (P. 1870). Enoch's Point (P. 1873). Stockyard Creek (P. 1876). Bethanga (P. 1878). Band and Albion Mine, Ballarat (P. 1880). Beechworth (P. 1882-3). Ajax Mine, Castlemaine (P. 1885). Chiltern, in granite (P. 1889). Swift's Creek, in a dyke (M.S. 1884). Grant, argentiferous; Upper Mitchell River; Ballarat; Granya (M.S. 1886). Walhalla; Doon (M.R. 1889). Alexandra (M.R. 1890). Upper Yarra (T.M.). Boggy Creek; Deptford; Baldhill Creek; Dargo; Wombat Creek; Haunted Stream (Cl.). Nearly all auriferous reefs below the water line; Amherst; Ararat; Blue Mountain; Bonang; Buchan; Cathcart; Egerton; Lauriston; Majorca; Maryborough; Steiglitz; Stawell; Woods Point (P.R. Vol. 3). Bethanga (M.R. 1896). See note after *iron ores.*

MOLYBDENITE.—Yackandandah and Reedy Creek, fine hexagonal plates in quartz veins traversing granite; the Breweries, near Maldon (M. 1866). Latrobe River (B.S. 1872). Yea, in granite; Bradford Lead, Maldon, in rock crystal and cairngorm; Nuggetty Reef, Maldon; Mount Moliagul (M. 1870). Wattle Gully Reef, Castlemaine, in quartz (P. 1876). Near Berlin, in quartz (P. 1878). Bulgoback, Gippsland (P. 1879-80).

Harcourt, in granite (P. 1882-3). Beechworth; Lee's Creek (M.R. 1889). Ballarat; Buffalo River (T.M.). Myrtleford (M.H.). Barwidgee; Mount Buffalo; Little River (P.R. Vol. 3). Cape Woolamai, in granite; Victoria Valley, veins in syenite (Pd.). *Molybdenum* (Molybdenite? J.A.A.), from Wattle Gully, plates several inches in width, also tabular crystals in elvanite, etc. (P. 1876).

Molybdic ochre.—Yea, in hollows of molybenite; Mount Moliagul, coating joints of quartz (M. 1870). See note in the same volume.

Monazite.—Bethanga (P. 1881). Strathbogie Ranges? (P. 1880).

Moonstone.—See *Adularia*.

Mountain leather.—Kangaroo Hill and Table Hill, near Tarilta, thin, paper-like laminæ in the joints of white silurian mud-slate at the bottom of gold-drifts (M. 1866). Maldon, at the 690ft. level (T.M.). South German Reef, Maldon, at the 900ft. level, with calcite in quartz (T.S.H.).

Muellerite.—Skipton Caves ("Chem. News," 13th May, 1887). Mr. Macivor, in this journal, says this is a mineral new to science, and he promises to describe it in a future paper.

Muscovite.—One of the principal constituents of our granites and grey felspar porphyries; Beechworth, light green crystals in sandstone; near Harrow; near Anakies, in granite hills; Reid's Creek, etc (M. 1866). Daylesford (B.S. 1872). Mount Wills, in dykes; North Gippsland, in granite (Cl.). Hill's Corner, Baynton, in granite, along its junction with the lower silurian (N.M.). Maldon, with garnets and orthoclase, at a depth of 1120 feet (P. 1882-3). Station Peak; Grampians; Beechworth; Inglewood; Yackandandah; Coliban River (T.M.). Glenelg (P.R. Vol. 3). Near Heathcote, in sandstone (H. 1896).

Nacrite.—A specimen from Maldon is shown in the Technological Museum.

NATROLITE.—Phillip Island, in basalt (M. 1866). Flinders (T.M.). Chetwynd, in older basalt (T.M. Catalogue, 1894).

NEPHELINE.—Phillip Island, in older basalt (P. 1877-8). (Record apparently altered to *Apatite* without comment. See T.M. Catalogue, 1894, p. 43).

NICKEL.—Western Port district, in native iron (B.S. 1861). Thompson River Copper Mine, sparingly (P.R. Vol. 6).

NEWBERYITE.—Near Warrnambool, in guano deposits; Skipton Caves, in guano deposits ("Chem. News," 13th May, 1887). For analysis see the same journal.

NONTRONITE.—(variety of chloropal). Maldon, small seams and patches in reefs (M. 1866). New Chum Reef, Bendigo (P. 1874). Mount Steiglitz (T.M.). Granya (P. 1882-3).

OBSIDIAN.—The following have been recorded as occurrences of obsidian (see note below). In pieces on basaltic plains round Mount Elephant and Mount Eeles (? Mount Eccles, J.A.A.); also, strange enough, over the tertiary mud plains of the Wimmera, far removed from any basaltic craters or points of eruption; near Geelong, in basaltic quarry; Broadford, in basalt; Spring Creek, near Daylesford, pieces in tertiary drift (M. 1866). Ballarat, from western deep leads (P. 1874). Buttons from the lava floors of Western District; Geelong and Ballarat, buttons and hollows bombs (T.M. Catalogue, 1824). Barwon River (T.M.). Ararat; Ingleby (P.R. Vol. 3). For analyses see Catalogue N.M. 1868). *Note*—Mr. A. W. Howitt, F.G.S., tells me that he has analysed a number of specimens of the so-called obsidians, and has found them in every case to be basic, and that we have no obsidian as we now know it; but that our volcanic glass is really tachylite. Mr. Rule, late of the Technological Museum, expressed the same opinion to me on another occasion.

ODONTOLITE (Bone turquoise).—Bairnsdale, a fossil tooth of a kangaroo (T.M.).

OLIGOCLASE.—Mount Franklin and the Anakies, in scoriaceous basalt; Lake Purrumbete; Black Hill, near Kyneton, in granite; Tarrengower, in granite; Harcourt, in granite (M. 1866). Kyneton (Sel. 1861). Anakies,

with olivine and hornblende (N.M.). For analysis see N.M. Garden Gully Reef, Bendigo, in a basalt dyke (P. 1876). Phillip Island, in older basalt (P. 1877-8). Tangil (P. 1881). Mount Elephant; Mount Shadwell; Learmonth; etc. (T.M. Catalogue, 1894). Mount Lookout, Gippsland (T.M.). Dargo, in aplite (H. in Trs. R. S. Vic., 1887, p. 137).

Olivine.—Common in the newer basalts, except where they occur as true dolerite; irregular shaped masses near craters and points of eruption, as at Mount Franklin; Anakies; Gisborne Hill; Warrion Hills; etc. (M. 1866). Garden Gully Reef, Bendigo, in a dyke (P. 1876). Basin Bank Lakes, massive (P. 1875-6). Camperdown, bombs (P. 1877-8). Mount Gambier; Mount Leura; Learmonth (P. 1878). Tangil (P. 1881). Sunbury (P. 1885). Daylesford (P. 1887). Mount Shadwell (P. 1884). Mitchell River (Cl.) Snowy Bluff (H. teste Cl.). Western Port, in older basalt; Mount Lookout, Gippsland (T.M.). Cape Schanck; Coal Creek; Coimadai Creek; Dargo High Plain; Kilmore; Melton; Waterhouse Island, in Bass Strait (P.R. Vol. 3). Dargo, in igneous dyke (H. in Trs. R.S. Vict., 1877).

Olivenite.—Wilson's Reef, St. Arnaud, reniform coatings in hollows (M. 1866).

Onyx.—Reported from Beechworth and Yarra basin, very scarce (M. 1866).

Opal.—*Common opal.* Sunbury, in basalt; Gelantipy, large deposit, mostly yellowish or dark brown (Cl.). Phillip Island; Moe (P. 1880). Near Morwell (P. 1882-3). Woodend (M.S. 1886). Buchan (P. 1888). King River, with chalcedony; Moolort: Gisborne; Kyneton; Talbot; Blackwood; near Bairnsdale; Joyce's Creek (T.M.). *Precious opal.* Beechworth, rare (M. 1866). Gelantipy; Sassafras Creek; Woori Yaloak (P.R. Vol. 3). *Fire opal.* Ovens (Bl. in Trs. R.S. Vic., 1866). Beechworth (Bl. 1866). Head of Woori Yaloak River (B.S. 1872). *Pitch opal.* Gippsland (T.M.). *Semi-opal.* Maldon (T.M.). Near Melbourne, in basalt; Gisborne; Bacchus Marsh; Riddell's Creek (M. 1866). *Opaline*

quartz. Heathcote, in tertiary drift (N.M. Beechworth; Essendon; Keilor; Mount Duneed; Shady Creek (P.R. Vol. 3).

OPALIZED WOOD.—See *Silicified wood.*

OPAL JASPER.—See *Jasper.*

ORIENTAL EMERALD (Green sapphire).—Pakenham (M. 1870). Near Cooma (Bl. in Trs. R.S. Vic., 1866). Jim Crow Ranges; Donnelly's Creek; Ovens River; near Daylesford (Bl. 1866). (Dr. Bleasdale called this "the rarest of all gems"). Beechworth; Dry Creek; Stockyard Creek; Upper Yarra (P.R. Vol. 3). A green star sapphire from Ovens (Bl. in Trs. R.S. Vic., 1865-6).

ORIENTAL TOPAZ (var. sapphire).—Pakenham (M. 1870). Ovens (Bl. in Trs. R.S. Vic., 1865 6).

ORPIMENT.—Deptford; Mount Baldhead, Gippsland, in cavities of pyritic quartz (Cl.). *Sulphide of arsenic* at Stawell (P.R. Vol. 3).

ORTHOCLASE.—The principal component in all our granites; veins in the neighbourhood of the granite and silurian boundaries at Maldon; Elphinstone; Harcourt; etc.; in detritus at Timbillica Valley, Gippsland; and near Kangaroo Flat, Talbot: Bradford, pink crystals; Reid's Creek, Beechworth (M. 1866). Mount Barker and Expedition Pass, Castlemaine, large crystals (T.S.H.). Mount Taylor and the same series of rocks throughout North Gippsland (Cl.). Kyneton; Amherst (Sel. 1861). Back Creek, Baynton (N.M. 1868). Cape Woolomai, with albite (P. 1878). Beechworth (P. 1879-80). Maldon, with garnets and muscovite (P. 1882-3). Lal Lal; Phillip Island (T.M.). Dargo, in aplite (H. in Trs. R.S. Vic., 1887, p. 137).

OSMIRIDIUM.—Stockyard Creek, a few grains (P. 1873). Turton's Creek, South Gippsland, small quantities in the alluvial workings (P. 1880-1). Waratah Bay (T.M.).

PALAGONITE TUFA.—Collingwood (P. 1889).

PHACOLITE.—Richmond basalt quarries (P. 1876). South Clunes (P. 1879-80). Collingwood, in basalt (P. 1880). Brunswick quarries (P.R. Vol. 6).

PHARMACOSIDERITE. — Castlemaine (Sel. 1861). Port Phillip Company's Mine, Clunes, small crystals; Beehive Reef and German Reef, Maldon; Armenian Reef, St. Arnaud; Maryborough; Bendigo; Crooked River (M. 1866). Boggy Creek, near Mount Taylor, cubic green crystals, in crevices of greenish-stained quartz (Cl.). *Arseniate of iron* from Gippsland (B.S. 1872). St. Arnaud (B.S. 1866). Beechworth (P.R. Vol. 3).

PHILLIPSITE.—Richmond, in basalt (N.M. 1868). Kyneton, in basalt (M. 1870). Malmsbury, in basalt (P. 1878). Collingwood, in basalt (P. 1880), Phillip Island, rare (T.M.). Brunswick quarries (P.R. Vol. 6). For analysis see M. 1870.

PHOLERITE.—Blacksmith's Gully, Fryerstown, in kaolin (N.M. 1868). Albion Company's Reef, Steiglitz, with bournonite, tetrahedrite, gold, etc. (M. 1870). Eaglehawk Reef, Maldon (P. 1877-8). Bendigo (P. 1885). Raspberry Creek, in decomposed diorite dyke (T.M). Ajax Reef and Garfield Reef, Castlemaine (T.S.H.) Snowy Creek (P.R. Vol. 4).

PHOSPHATE OF AMMONIA.—Skipton Caves, in guano deposit ("Chem. News," 13th May, 1887).

PHOSPHATE OF IRON.—See *Vivianite*.

PHOSPHATE OF MAGNESIUM.—Skipton Caves, in guano deposit ("Chem. News," 14th May, 1887).

PHOSPHORITE.—Bruthen Creek, Gippsland, in decomposed basalt (M. 1870). For analysis see the same work.

PHOSPHORUS.—In brown iron ore at Blackwood; Strath Creek; Ghost Creek (P. 1878).

PINITE.—Maldon (P. 1882-3). Beechworth, in granite (L. 1873, p. 199).

PLAGIOCLASE. —Omeo, in granite; near Heathcote, in granite and sandstone (H. 1896).

PLAGIONITE.—Buchan (P. 1871).

PLATINUM.—Stockyard Creek, Gippsland, in alluvial workings (P. 1874).

PLEONASTE.—Upper Yarra, in gold-drift, with sapphire, zircon, etc.; Blue Mountain; Ballan (M. 1866). Yarra Basin, with stream tin (B.S. 1866). Colac (P. 1871). Bass

River, Western Port, in sand (P. 1883). Haskett: Woodend (M.S. 1886). Eaglehawk (M.S. 1887). Daylesford; Glenlyon (P. 1889). Granya (M.R. 1889). Benalla; Bullarook (T.M.). Corindhap; Jindivik (P.R. Vol. 7). Ballarat; Beechworth; Mansfield (P.R. Vol. 3).

PLUMBAGO.—See *graphite*.

PRASE.—Rather rare. Specimen Gully Reef, Castlemaine: Heathcote, in some of the reefs (M. 1866). Lady Gully Reef, Castlemaine (Sel. 1861). Blacksmith's Gully Reef and Ajax Reef, Castlemaine (T.S.H.). Maldon (T.M.). Blackwood; Clunes; Bendigo; Stawell (P.R. Vol. 3).

PREHNITE.—Snowy Bluff, Gippsland (H. teste Cl.).

PROCHLORITE (chlorite peach).—Grampians; Ballarat; German Reef, Maldon (T.M.). Heathcote, in diabase rocks (H. 1896).

PSILOMELANE.—In the quartz reefs of all the gold fields, as mammillary crusts, concretions, cementing material, coatings over gold, quartz, pyrites, etc. (M. 1866). Upper Yarra, in quartz (B.S. 1872). Mount Taylor district: Bruthen; Boggy Creek; Omeo; Gelantipy (Cl.). Molesworth; Walhalla; Jan Juc (P.R. Vol. 7). Seymour (P. 1873). Near Kilmore (P. 1885). Jameson River; Mount Buller; near Avoca, with brown tourmaline (P. 1877-8). Near Seaton, Gippsland (P. 1879-80). Molesworth, with cobalt and copper (P. 1880-1). Gippsland; Dunolly (T.M.). Bendigo (P.R. Vol. 3). Riversdale (P.R. Vol. 4). Tangil (P.R. Vol. 6).

PYRITES.—The most common ore in auriferous quartz reefs. Occurs in narrow veins or impregnated. Crystals and druses frequent. Always more or less auriferous. Ovens district; Mount Blackwood; Crooked River; Tarrengower; St. Arnaud; Landsborough: perfect crystals at Wattle Gully, Castlemaine; Malmsbury; Maryborough; Tarilta, etc.; crystals at Muckleford; Woods Point, etc. (M. 1866). Many localities in the Castlemaine district, as Wattle Gully, cubes in sandstone; South

Wattle Gully Mine, octahedra; Devonshire Mine, pentagonal dodecahedra (T.S.H.). Haunted Stream; Omeo; Dargo; Nicholson River, one-inch cubes; nearly all the gold-bearing reefs of East Gippsland; Mount Lookout, in lignite; Clifton Morass, pseudomorph after wood (Cl.). Bendigo; Howqua River; Lancefield; Moyston (N.M. 1868). Woodside, Gippsland (P.R. Vol. 7). Maldon (P. 1884). Pleasant Creek, secondary (P. 1876). Bethanga, mixed with mispickel and copper pyrites (P. 1877-8). Moe, secondary (P. 1880). Daylesford; Clunes (P. 1879-80). Jan Juc, secondary (M.S. 1884). Golden Point Lead, Ballarat, wood converted into pyrite; Fryerstown (T.M.). Burke's Flat; Dunolly; Alexandra; Ararat; Beechworth; Blakeville; Bright; Buchan; Crossover Creek; Deptford; Diamond Creek; Frankston; Hoddle Range; Gaffney's Creek; Jameson; Majorca; Myrtle Creek; Panton Hill; Redbank; Snowy Creek; Stockyard Creek; Stringer's Creek; Tarnagulla; Woods Point; Yackandandah; Steiglitz; Tangil; Daylesford; Stawell; stalactite at Ballarat (P.R. Vol. 3). Near Heathcote, in diabase rocks (H. 1896). Dandenong Ranges; Queenstown; Mount Useful (M.R.F.).

Pyrolusite.—Near Kilmore (M.R. 1885). Drouin (P. 1881). Upper Yarra (N.M.). Mount Taylor (Cl.). Indented Heads (Sel. 1861). Pleasant Creek district; Ararat (M. 1866). Fifteen miles from Moe, cementing medium in brecciated quartz (Pr. R.S. Vic., 1880, p. 145).

Pyromorphite.—Small, light-green prisms at Nicholson's Reef, Castlemaine; Chrysolite Reef, St. Arnaud; Avoca; Maryborough; Bendigo (M. 1866). In the mineral veins throughout the colony (B.S. 1866). Fone's Reef, Burke's Flat (P. 1874) Dry Gully, near Mount Livingstone (Trs. R.S.S.A. Vol. 7, 1883-4). *Phosphate of lead* from Dargo High Plain (P. 1872). St. Arnaud, with silver ores (P. 1874). Ararat (P.R. Vol. 3).

Pyrope (garnet).—Ovens (Bl. in Trs. R.S. Vic. Vol. 8, 1866).

Pyrophyllite.—A mineral answering to this in appearance and behaviour before the blow-pipe was found in a euritic

granite dyke at Beechworth (M. 1870). Maldon, with calcite, dolomite, etc. (M.S. 1875-6).

PYRRHOTITE.—Howqua district, in the reefs; Maldon, in several reefs: Specimen Gully Reef, Castlemaine, etc. (M. 1866). Green Gully, near Newstead (P. 1874). Bethanga (P. 1886). Near Stawell (T.M.). Lancefield: Mount Timbertop; Waratah Bay (P.R. Vol. 3).

QUARTZ (common vein quartz).—The massive variety, the most common of colonial minerals, is represented by the thousands of reefs that traverse the silurian rocks, and also as extensive beds of quartz rock, sometimes nearly forty feet thick, in the tertiary formations. Druses occur in all the reefs (M. 1866). In veins on all the gold fields in East Gippsland (Cl.). *Granular quartz* at Mount Franklin, in basalt: *stalagmitic* at Back Creek, near Baynton, in a cave in granite; *mammillated quartz* at Phillip Island (N.M.). *Cavernous quartz* from Gippsland (P. 1883). *Quartz enclosed in basalt* from Anakies; Phillip Island; Mount Franklin (T.M.). *Iridescent quartz* at Mount Taylor (Cl.). See limonite for other occurrences of this iridescent film.

QUARTZ CRYSTALS.—See *Rock crystal.*

QUICKSILVER.—See *Mercury.*

RANDANITE.—See *Infusorial earth.*

REALGAR.—Deptford and Mount Baldhead, in quartz cavities (Cl.) *Sulphide of arsenic* occurs at Stawell (P.R. Vol. 3).

RED OCHRE.—Generally distributed in tertiary rocks (Sel. 1861). Frequent in the tertiary rocks round the coast (M. 1866). All parts of the colony; extensive deposits in connection with the older basalt of Phillip Island; also at Ballan; Blackwood; Daylesford; Bacchus Marsh; Tarwin River; Anderson's Inlet (P. 1876). White Hills, Bendigo (P. 1877-8). Boggy Creek; Wombat Creek; Omeo (Cl.). Near Bendigo (M.S. 1875-6). See also *hematite.*

REDRUTHITE.—See *chalcocite.*

RETINITE.—Bruthen Creek, Gippsland (P. 1880-1). Woodside, Gippsland (P.R. Vol. 7). Near Cape Bridgewater (P.R. Vol. 3). See also *mineral resin* and *copaline.*

RHODOCHROSITE.—Port Phillip Mine, Clunes (T.M.).

RIEBECKITE.—Near Heathcote, in diabase rocks (H. 1896).

RIPIDOLITE.—Near Heathcote, in diabase rocks (H. 1896). See *prochlorite.*

ROCK CRYSTAL.—On all the gold fields (Sel. 1861). Druses of crystals occur in nearly all the reefs (N.M.). For figures of crystals see M. 1870.

ROCK-MILK.—Collingwood, in basalt (T.M.). See also *calcite.*

ROSE-QUARTZ.—See note to *amethyst.*

RUBELLANE.—Footscray and Vaughan, in decomposed basalt, small brownish-red tables (M. 1866).

RUBELLITE.—Bradford Lead, Tarrengower, in quartz crystals (P. 1868).

RUBY (oriental).—Mount Eliza, very rare (M. 1866). Pakenham (M. 1870). Sebastopol, near Beechworth: Studley Park, Melbourne; several localities where sapphire is found (P. 1870). Stockyard Creek, Gippsland (P. 1878). Rubies are also recorded from Traralgon Creek (P. 1877-8). Berwick: Daylesford: Mount Martha (P.R. Vol. 3).

RUTILE.—Blue Mountain and Upper Yarra, in the wash-dirt (M. 1866). Bass River: Omeo: head of Mitta Mitta River (T.M.). Gippsland: Epsom Flat: Bendigo, in quartz crystal (P. 1874). Near Pakenham (P. 1878). Benak (P. 1880-1). Broadford (M.R. 1889). Maldon, in granite (T.M. Catalogue 1894). Beechworth: Daylesford: Stockyard Creek (P.R. Vol. 3). Kingower (P.R. Vol. 5). Dry Gully, near Livingstone (Stirling in Trs. R.S.S.A., 1883-4).

SALT (common). Saline lakes in the Western district, crusts up to two inches thick (M. 1866). Lake Cundare (M.R. 1890). Stawell: Lakes St. Mary: Parupa: Williamschase: lakes in the Avoca district (P.R. Vol. 3).

SANIDINE.—Coleraine, in volcanic rock (J. Dennant in Report of Australasian Association for the Advancement of Science, 1893).

SAPPHIRE.—Castlemaine, etc. (B.S. 1861). In the gold-drifts of Beechworth: Daylesford: Vaughan: Blue Mountain: Upper Yarra: Mount Eliza: Inglewood, etc. (M. 1866). Tubba-Rubba Creek, Mornington: Trentham;

Yarra Ranges (B.S. 1866). Dandenong Creek (Bl. 1866). Ovens, *white*, *yellow*, *blue*, and *green* varieties: Fryer's Creek; Gippsland (Trs. R.S. Vic., 1866). Near Redesdale; near Cape Otway (N.M.). Pakenham; Mount Greenock Lead (M. 1870). Blackwood; Mansfield; Dry Creek; Ballarat (P. 1870). Axedale: Campaspe River; Dry Diggings; Colac (P. 1871). Head of Woori Yaloak River; basin of Little Yarra River; Dandenong Ranges (B.S. 1872). Fryerstown, in drift (P. 1878). Garlick's Lead (P.R. Vol. 7). Glenlyon (P. 1889). Gembrook (M.R. 1890). Bairnsdale; Upper Boggy Creek, Gippsland (Cl.). Stockyard Creek; Benalla; Yarragon; Bass River; Benambra (T.M.). Alexandra; Berwick; Bunyip River; Buninyong; Crossover Creek; Franklin River; Jim Crow diggings; Latrobe River; Lintons; Sassafras Creek; Steiglitz; Tarwin River (P.R. Vol. 3). See also *Adamantine Spar*, *oriental emerald*, *oriental topaz*.

SARDONYX.—Beechworth and Yarra basin, very rare (M. 1866).

SCHEELITE.—Nuggety Reef, Maldon (M. 1870). Maldon, in considerable quantities, with calcite (M.S. 1875-6).

SCHORL.—See *tourmaline*.

SCOLECITE.—Preston Vale, on decomposed granite; Yackandandah, on a dense greenstone (M. 1870).

SCORODITE.—Crooked River, crystals; Blucher's Reef, Maryborough; Beehive Reef, Maldon (M. 1866). Poverty Reef, Dunolly, green crystals in quartz (N.M.) Wentworth River (P.R. Vol. 7. Bethanga (P. 1879-80). Strathbogie Ranges (P. 1880). Monument Creek (M.S. 1885). Doon (M.R. 1889). Broadford (T.M.). *Arseniate of iron* from Gippsland (B.S. 1872). St. Arnaud (B.S. 1866). Beechworth (P.R. Vol. 3).

SEEBACHITE.—See *phacolite*.

SELENITE.—See *gypsum*.

SELWYNITE.—Near Heathcote, a vein in upper silurian rocks, traversed by thin seams of talc and accompanied by two other undetermined minerals (N.M.). For analysis see N.M. and M. 1870. A mineral closely allied was recorded from Benalla (M.R. 1889).

SENARMONTITE.—Costerfield (P. 1876). See note under *valentinite.*

SERICITE.—Near Heathcote, flakes in silurian and metamorphic rocks (H. 1896).

SERPENTINE.—Mount Timbertop (M. 1870). Analysis in the same work. Mirboo (M.S. 1884). Gippsland; Wannon Falls (P.R. Vol. 7). Beechworth; Mount Wellington; Waratah Bay, produced by the decomposition of gabbro (T.M. Catalogue 1894) Benalla (P.R. Vol. 3). Mount Bulla; Howqua River (P.R Vol. 4). Dargo, pseudomorphs after olivene (H. in Trs. R.S. Vic., 1887).

SIDERITE.—See *Chalybite.*

SILICATE OF IRON.—Maldon; Snowy River (P.R. Vol. 3).

SILICIFIED WOOD.—Barrabool Hills; banks of the Barwon River, near Geelong; Sutherland's Creek, near Maude; Bacchus Marsh district; several places in Gippsland (M. 1866). Bulla Bulla Creek (M.R.F.). Large blocks in some of the tertiary formations; parish of Durdidwarrah, in hard silicious rock underlying older basalt and tertiary beds; Glenmaggie, in pebble drift (N.M.). Swift's Creek (P. 1878). Near Morwell; Sloan's Punt, on the Goulburn River (P. 1882-3). Western Port (P. 1884). Macalister River (P. 1891). Glenelg River; Coleraine (T.M.). As *wood opal* it is recorded from Bass River; Grampians; the gold-drifts of Daylesford; Ballarat, etc. (M. 1866). Between Moe and Morwell (P. 1883). As *fossil wood*, from Footscray; Lal Lal (P. 1880). Laanecoorie (M.R. 1889). Waratah Bay; Stawell (P.R. Vol. 3). Hepburn; Omeo (M.R.F.).

SILVER (native).—St. Arnaud, in the silver reefs (M. 1866). Landsborough, in thin veins of quartz, with gold, copper and lead; Stawell (P. 1871). Dry Gully, near Mount Livingstone (Stirling in Trs. R.S.S.A., 1883-4). *Silver* is recorded from Howqua Hills, in quartz; junction of Delatite and Goulburn Rivers, in quartz; Tangil, in earthy siderite (P.R. Vol. 7). Omeo (Cl.). *Silver ores* from Pleasant Creek (B.S. 1866). Woods Point; Landsborough (P. 1869). Ringwood, in quartz, one sample (B.S. 1872). Bairnsdale; Mount Wills; Glen Wills; Gelantipy; Mansfield; Bemm River (M.R. 1896). See under the names of the different silver ores.

SMOKY QUARTZ.—See *cairngorm.*

SPECULAR IRON.—Sandy Creek, Tarrengower, tabular crystals, sparingly; Malmsbury, in dolerite and dolerite porphyry (M. 1866). Grampian Mounts (N.M.). Bonang, with magnetic iron (P. 1876). Bairnsdale (M.R. 1889). Dookie; Mia Mia; Riversdale: Snowy Creek; Yarra River (M.H.). Footscray; Redesdale (P.R. Vol. 3). Moyston (P.R. Vol. 4). *Iron glance* from Western Port (P.R. Vol. 7). Beechworth (M.S. 1886). Mount Korong, in granite (N.M). County Millewa (P. 1884). Lake Tyers (M.R.F.). See also *hematite, red ochre, micaceous iron.*

SPHÆROSIDERITE.—In the basalt of many localities, as Loddon outliers; Sunbury; Campaspe Falls; Ballan, etc. Nodular masses in the mesozoic coal measures near Geelong (M. 1866). Essendon (N.M.). *Carbonate of iron* occurs at Steep-bank Creek, Wannon district; Italians' diggings, Barfold, junction of basalt and sandstone (N.M.). Malmsbury, in basalt (P. 1871). Sarsfield; Pleasant Creek (T.M.). *Clay iron ore* at Avoca (P. 1874). See also *chalybite.*

SPHALERITE.—Specimen Gully, Castlemaine (Sel. 1861). In the auriferous reefs of perhaps all our gold fields, but more frequently in Russell's Reef, near Malmsbury; Nuggety Reef, Maldon; Wilson's Reef, St. Arnaud; Morse's Creek; Ovens district, etc. (M. 1866). Francis Ormond Reef; Crown Nimrod Reef; Mopoke Gully; Scotchman's Gully, all near Castlemaine (T.S.H.). St. Arnaud, in the silver mines (N.M.). Buchan, in lead mine; Back Creek; Swift's Creek; many reefs at Bendigo; Steiglitz; Inglewood; Rushworth (P. 1873). Victoria Reef, Maldon (P. 1874). Foster (P. 1876). Bethanga (M.S. 1884). Stuart Mill, from core of diamond drill; Ballarat; Percydale (M.S. 1886). Maldon (T.M.). Wombat Creek (M.R. 1890). Boggy Creek; Buchan; Haunted Stream; Omeo (Cl.). Murrindall; Wangaratta (T.M.). Amherst; Blackwood; Clunes; Daylesford; Gordons; Llanelly; Stawell (P.R. Vol. 3).

SPHENE.—Near Heathcote, in diabase rocks (H. 1896).

SPINEL RUBY (Balas ruby).—In the auriferous drifts of the colony (B.S. 1866). Beechworth (Bl. 1866).

STANNITE.—Australian Alps, near Pilot Creek, in a quartz matrix (Stirling in Trs. R.S.S.A., 1883-4).

STEATITE.—Strathloddon, in silurian rocks (M. 1866). Dunolly P.R. Vol. 3). *Pseudo-steatite* from Alexandra; Lauriston; Woods Point (P.R. Vol. 3). See also allophane and talc.

STEINMANITE (var. galena).—Murrindall (Pr. R.S. Vic., 1880, p. 145).

STIBLITE (antimony ochre).—Heathcote; Templestowe; Maryborough; Upper Yarra (Sel. 1861).

STIBNITE.—Costerfield, massive; Reedy Creek; Whroo; Maldon; Templestowe; Woods Point; several reefs at Ballarat; Daylesford; Maryborough; Blackwood; Caledonian diggings; Anderson's Creek (M. 1866). Sunday Creek, near Kilmore; Tooborac (B.S. 1866). Jameson (P.R. Vol. 7). Munster Gully, Dunolly; Upper Yarra (M. 1870). Bacchus Marsh (P. 1873). Bendoc; Dargo; Swamp Creek; Buchan (Cl.). Mount Bullen, near Mansfield (P. 1883). Gippsland; Ararat (P. 1870). Alexandra; Port Albert; Yea; Northcote (P. 1868). Box Hill; Nunawading; Wapautaki Creek, near McIvor; Bendigo; Murchison (P. 1874). Broadford; Queenstown; Redcastle; McIvor (T.M.). Big River, fifteen miles from Enoch's Point (M.R. 1887). Morwell; Merton; Delatite district; Wombat Creek (M.R. 1889). Heathcote; Rutherglen (B.S. 1866). Bulla; Coy's diggings; Clunes; Donovan's Creek; Doogalook; Mount Useful; Snowball Hill; Sunbury (P.R. Vol. 3). Steiglitz; Bethanga; Warrandyte; Tallarook (M.H.). Near Chiltern (M.R.F.). For analysis see B.S. 1866.

STILBITE.—Barrabool Hills (P. 1880). Harcourt, druses in granite (T.S.H.).

STRONTIA.—See note to *barite* from Maldon.

STRUVITE.—Skipton Caves, in guano deposit, light yellow, subtransparent, crystalline particles, and perfect crystals (M. 1870). For analyses see M. 1870, and "Chem. News," 13th May, 1887.

Sulphur (native).—Costerfield antimony reef, in crevices; Fentiman's Reef, Maldon; St. Arnaud; Specimen Gully Reef, Castlemaine (M. 1866). Woods Point (P. 1876). Clifton Morass, East Gippsland; Sarsfield, where mounds six feet high have been thrown up and free sulphur deposited in the crater-like basin (Cl.). Mallee (P.R. Vol. 7). Dandenong (P. 1878). Bendigo; Beechworth (P.R. Vol. 3).

Tachylite.—Near Geelong, in basalt (P. 1877-8). Collingwood (P. 1880), Richmond, in basalt; Phillip Island, in basalt (T.M. Catalogue 1894). Saltwater River; Talbot (T.M.). All the records of the occurrence of obsidian should probably be under tachylite. See note after *obsidian*.

Talc.—Near Heathcote, thin veins in selwynite (M. 1866). Beechworth (P.R. Vol. 3).

Talcosite.—Near Heathcote, in the selwynite (M. 1870). For analysis and description see M. 1870.

Telluric Iron (?)—Magnet Hill, near Baynton's, minute particles and small octahedra in basalt (P. 1873).

Tetrahedrite.—Albion Company's Mine, Steiglitz (M. 1870). Jameson (T.M.). Maryborough (P.R. Vol. 6). For description see M. 1870.

Thomsonite (comptonite).—Near Frankston, on granite (P. 1877-8). Heathcote, in diabase rocks (H. 1896).

Tin (Metallic).—Malmsbury, associated with tin-sand (P. 1882-3). Latrobe River (M.R.F.).

Tin-sand.—See *cassiterite*.

Titaniferous Iron Sand.—Abundant in the gold-drifts of perhaps all the gold fields; in the drainage channels from, and in the detritus of, basalt escarpments. As far as can be made out, it consists of two species, iserine and menaccanite (M. 1866). Samples have been received by the Mines Department from all parts of the colony. It usually contains garnets, sapphires, zircons, topazes, and, in some cases, cassiterite (M.S. 1875-6).

Topaz.—Ararat; Castlemaine; near Pleasant Creek (B.S. 1861). French Island and Flinders Island, crystals and rolled pebbles in tolerable abundance; Dunolly, blue and

white, in gold-drift; Woolshed; Sebastopol; Eldorado; Reid's Creek; Beechworth; Bendigo (M. 1866). Moonambel; Mountain Creek; Gippsland (Bl. 1866). Dr. Bleasdale says—"Wherever the blue topaz is found, there also the diamond may be looked for." Redesdale (N.M.). Mount Greenock, near Talbot (M. 1870). For an account of an interesting occurrence at Bradford Lead, Maldon, see M. 1870. Blackwood; Dry Creek; near Mansfield; Ballarat (P. 1870). Near Lilydale; Dandenong Ranges (B.S. 1872). Near Pakenham, in drift (P. 1878). Strathbogie Ranges (P. 1880). Gembrook (M.R. 1890). Crooked River (Cl.). Colac; Yackandandah; Myrtleford Creek (P. 1871). Coburg; Daylesford; Franklin River; Majorca; Sassafras Creek; Stawell; Upper Yarra; Stockyard Creek (P.R. Vol. 3). *Smoky topaz* at Beechworth; Maldon; Upper Yarra (P.R. Vol. 3).

Torbanite.—Tyer's Creek, near Traralgon (P. 1874). For analysis see P. 1874.

Touchstone.—See *basanite*.

Tourmaline.—Maldon; Beechworth; Dandenong; St. Arnaud; Mount Alexander, etc.; a common accessory of granite. Abundant in some of the gold-drifts. Dandenong Ranges; Baynton's, in a granite vein; Ovens district; Wilson's Promontory; Berwick; etc.; crystals of transparent green tourmaline at Beechworth and bed of the Yarra River (M. 1866). Yarra Basin, with stream tin (B.S. 1866). Maryville Company, Dalhousie, in quartz; Specimen Gully, Barker's Creek (N.M.). Chiltern; Bright (P.R. Vol. 7). Myrtleford Creek; Yackandandah; Gippsland (P. 1871). Near Pakenham, green (P. 1878). Euroa (P. 1883). Yea, in pebbles (P. 1885). Bethanga (P. 1886). Neerim (M.S. 1884). Molesworth; near Franklin River (M.S. 1887). Gembrook; Agnes River (M.R. 1890). Expedition Pass, Castlemaine (T.S.H.). Omeo; Beenak; Upper Murray; Seymour (T.M.). Bruthen; Bemm River; Mount Wills (Cl.). Stawell (P.R. Vol. 6). Alexandra; Barnawartha; Belvoir; Campaspe; Fanwick; Linton's;

Majorca; Mount Koorong; Mount Singapore; Bendigo; Snowy River; Mount Tarrengower; Lilydale (P.R. Vol. 3).

TRAVERTINE.—Limestone Creek, near Castlemaine; (T.S.H.).

TREMOLITE.—Maldon, with calcite, dolomite, etc. (M.S. 1875-6).

TRIPOLITE.—See *infusiorial earth.*

TUNGSTITE.—Maldon (Pr. Rs. Vic. 1880, P. 145).

TURQUOISE.—King River, Omeo (P. 1890).

URALITE.—Waratah Bay, in gabbro (T.M.). Near Heathcote, in diabase (H. 1896).

VALENTINITE.—Costerfield; Morning Star Reef, Woods Point, sparingly (M. 1866). Munster Gully, Dunolly, 62½ to 64 per cent. of antimony (P. 1874). Ringwood (P. 1878). Cashel (T.M.). Dargo; Heathcote; Whroo (M.H.). Upper Bendoc; Blackwood; Caledonia; Coy's diggings; Warrandyte; Yea (P.R. Vol. 3). *Antimony oxides*, without stating which kind, at Box Hill; Bendigo (P. 1874). Gippsland (P. 1870). Blackwood; Upper Yarra (P. 1872). Near Yea; Warrandyte; Upper Bendoc (P. 1873). Yangardook (P. 1876). Merton (M.R. 1889). Big River (M.R. 1890). Ringwood, a mineral which looks like hydrous brown oxide of iron, but has up to 45 per cent. of antimony oxide (P. 1872). *Antimony ores*, without stating which ore, at Anderson's Creek; Steiglitz; near Maryborough (B.S. 1861). Buchan (P. 1871). Thomastown, near Merri Creek (P. 1877-8). Sunday Creek, near Kilmore (P. 1883). Coy's diggings (P. 1884). Kanambra (M.R. 1896).

VIVIANITE.—Nicholson's River, near Bairnsdale, crystals in silurian sandstone; Phillip Island, earthy, in older basalt; Bruthen Creek, in older basalt; Ballarat, in shales and mudstones (N.M.). Ballarat, in basalt; Port Addis; Geelong; Guano islands of Bass Straits; Buckland River (M. 1870). Richmond (P. 1868). Johnson's Creek, Alexandra (P. 1873). Maldon, with calcite and dolomite (M.S. 1875-6). Wannon River, near Hamilton (P. 1884). Princetown (M.R. 1889). Charlotte Plains (P. 1891). Dunolly; Mount Alex-

ander (T.M.). Sarsfield (H. teste Cl.). Port Albert (M.H.). Traralgon (P.R. Vol. 3). Woods Point (M.R.F.). *Phosphate of iron* at Omeo; Snowy Creek; Smythesdale; Tarwin Creek (P.R. Vol. 3).

WAD.—Near Merton, in Goulburn Valley (M. 1866). Boggy Creek; Merrigig Creek, with quartz (Cl.). Clifton Creek, in soft, slaty rock; some of the gold fields (B.S. 1872). Near Walhalla, in joints of a decomposed diorite dyke; Little Dorrit Mine, Crooked River (P. 1880-1). Goulburn River (P. 1882-3). Bethanga (M.R. 1887). Upper Yarra; Hoddle's Creek (M.R. 1890). Beechworth (P. 1889). Rushworth (P. 1890). Near Yea; Molesworth; Warburton (P.R. Vol. 7). Landsborough; Clunes; Dunolly; Strathloddon; Maldon: Caledonian diggings (T.M.). Snowy River; near Black Mountain (P. 1874). See also *asbolite*.

WAVELLITE.—Two miles north of Lancefield, in lower silurian graptolite shales, yellowish or greenish disc-like plates (M. 1870). Beechworth (T.M.).

WITHERITE.—Gippsland; Omeo, with pyrites, lead ores, etc.; Buchan; Corner Inlet (P. 1870).

WOLFRAM.—Near railway cutting at Big Hill; Bendigo line, in quartz; Sandy Creek, Maldon, in quartz; Dandenong; Upper Yarra; Ramshorn Gully, in gold-drifts (M. 1866). Between Sandy Creek and Loddon River, eight miles from Maldon, with schorl, etc. (N.M.). Near Ballarat, in quartz; Nuggetty Reef, Maldon, with scheelite, etc. (M. 1870). Linton's (P.R. Vol 7). North Gippsland (P. 1880). Granya; Swift's Creek; Chiltern (T.M.).

WOLFSBERGITE.—(Antimonial copper). Costerfield antimony reef, scale-like crystals (M. 1866).

WOOD-OPAL.—See *silicified wood*.

YELLOW OCHRE.—See *limonite*.

ZEOLITES.—Gelantipy (Cl.). Ararat; Ballan; Smythesdale (P.R. Vol. 3). Broken River (P.R. Vol. 4). Near Heathcote, in diabase rocks; (H. 1896). See also each zeolite under its own name.

ZINC (Native).—Collingwood, in a cavity in basalt, one specimen only, about 19 ounces in weight; small nodules from

Creswick Creek and Daylesford (M. 1866). Chrysolite Hill, St. Arnaud (P. 1873). Bendigo; St. Arnaud: Maldon; Gippsland (P. 1868). Mitta Mitta River, in auriferous sands (Rutley's Mineralogy, p. 173). Snowy River (P.R. Vol. 3).

ZINC ORE from Wombat Creek (M.R. 1896).

ZIRCON.—Daylesford, crystals; in gold drifts of various localities (Sel. 1861). Generally abundant in the gold-drifts, especially Blue Mountain; Kangaroo; Tarilta; Guildford; Daylesford; Ballan; Upper Yarra; Beechworth. Transparent colourless grains at Hard Hills, Campbell's Creek, near Castlemaine; Yandoit; and Taradale, etc. (M. 1866). Yarra Basin, in stream tin; Tubba-Rubba Creek (B.S. 1866). Gippsland; Jim Crow Ranges (Bl. 1866). Near Lilydale (B.S. 1872). Mount Greenock Lead (M. 1870). Ampitheatre; Jindivic (P.R. Vol. 7). Blackwood; Dry Creek; Ballarat; near Mansfield (P. 1870). Axedale; Campaspe River; Dry Diggings; Colac; Steiglitz; Yackandandah; Myrtleford Creek (P. 1871). Snowy Creek, in iron sand (P. 1874). Walhalla, in creeks (P. 1876). Possum Hill, Orville; near Pakenham (P. 1877-8). Fryerstown; Stockyard Creek (P. 1878). North of Lake Learmonth, in its basalt matrix (T.M.). Castlemaine district (B.S. 1861). Bass River and Western Port, in sand; Bullarook, in iron sand (P. 1883). Moondara (P. 1887). Glenlyon (P. 1889). Mount Bulla; head of western branch of Yarra River (M.S. 1884). Haskett (M.S. 1886). Eaglehawk (M.S. 1887.) Tallarook; Gembrook (M.R. 1889). Toongabbie; Benalla; Werribee Gorge, near Ballan; Mornington (T.M.). Kiewa River (P.R, Vol. 6). Berwick; Bunyip River; Buninyong; Chiltern; Clunes; Cudgewa Creek; Euroa, Dandenong Ranges; Franklin River; Latrobe River; Loddon River; Upper Murray River; Rosedale; Bendigo; Sassafras Creek; Linton's; Woori Yaloak River (P.R. Vol. 3). See also *hyacinth*.

Art. X.—*The Burbung of the New England Tribes, New South Wales.*

By R. H. Mathews,

Licensed Surveyor.

(Communicated by Professor Baldwin Spencer).

[Read 9th July, 1896.]

In pursuing my professional duties as a surveyor in various parts of the New England district of New South Wales during a number of years past, I frequently met and was intimately acquainted with many of the head men of the native tribes scattered over that portion of the country, and took advantage of these opportunities to collect all the available details respecting their initiation ceremonies. As the result of my own observations, and from information obtained from the natives, I have prepared what it is hoped will be found a correct and tolerably full account of the ceremonies carried out amongst the tribes who occupied a strip of elevated country along the main dividing range, from about Moonbi to Ben Lomond, comprising what is called the "Table Land" of New England. The territory of these tribes extended down the eastern side of this range perhaps as far as Walcha, Hillgrove and Oban. On the west of the main range they included Bendemeer, and reached almost to Bundarra and Inverell, adjoining the Kamilaroi tribes all the way. The principal dialects spoken by them are the *Nowan* and *Yungpai*. They have the Kamilaroi organisation, being divided into four classes, with uterine descent, but the class names are different from those of the Kamilaroi tribes.* This part of the subject will be dealt with by me in another paper.

Generally speaking, the reader is invited to remember that, although the main features of the initiation ceremonies obtaining over a wide area may be essentially the same, there are several local variations in some of the details in different parts of it.

* See my paper on "The Kamilaroi Class System of the Australian Aborigines." Proc. Roy. Geog. Soc. Aust. (Q.), x., 1894, Plate I.

This is more especially true of the Kamilaroi and Wiradthuri tribes, occupying extensive tracts in the interior of New South Wales, whose ceremonies of initiation have been described by me elsewhere.* Even in the small strip of country occupied by the New England tribes, it is found that the Burbung of the southern half of the district is somewhat different in a few of the details to that of the northern half.

The Main Camp and Burbung Ground.—The locality selected for the main encampment is generally situated on a moderately level piece of ground, not far from water, and where plenty of wood for fuel is obtainable. It is also chosen in a part of the tribal territory where game is sufficiently abundant to afford a food supply for the people who are in attendance while the ceremonies last. The local tribe are the first to erect their quarters, and the other contingents who have been invited encamp around this as a datum point, each in the direction of the country from which they have come.

Every evening after dusk, and every morning at or before daylight, a bullroarer is sounded by one of the single men in the vicinity of the camp, and when this is heard, the men raise a shout in unison, and the elderly women commence to sing and beat their rugs as an accompaniment to their chants.

Adjacent to the main camp, a slightly oval or circular space, called *ūrfanbang*, about thirty feet in diameter, is cleared of all timber and grass, and the loose soil scraped off the surface in making it level is used to form the raised earthen embankment which surrounds it. This embankment is about a foot high, and is about eighteen inches wide at the base, tapering upwards to a narrow ridge along the top.

A narrow pathway (*indyoona*) leads from this circle to another cleared space of somewhat smaller dimensions, about a quarter of a mile distant, in a secluded part of the forest. This circle is likewise bounded by a raised earthen wall like the other one, and within it are two heaps of earth about a foot high, on the top of

* "The Bora, or Initiation Ceremonies of the Kamilaroi Tribe," Journ. Anthrop. Inst., xxiv., 411-427; *Ibid.*, xxv., 318-339. "The Burbung of the Wiradthuri Tribes," Journ. Anthrop. Inst., xxv., 295-318.

each of which a fire, called *toómeeóroo*, is kept burning.* Where the pathway meets each of these circles, there is an opening about two or three feet wide left in the embankment as an entrance to the space within.

On approaching the farther ring, on either side of the path above described are some tracks of an emu's foot cut in the ground, the outline of an iguana formed of raised earth, and some other figures The bark on the boles of a number of trees around this ring are marked with various wavy, zig-zag and oval patterns cut with a tomahawk. This marking is called *moombeera* or *mahendee*. Not far from the pathway, and in close proximity to the marked trees, is the horizontal figure of a man, larger than life size, lying prone on the ground. He is formed of raised earth, with a layer of mud or clay on the upper surface, and is called *Goign* or *Baiamai*.

Mustering the Tribes.—The messengers who are sent out to gather the tribes carry a bullroarer, some tails, boomerangs, and white stones. When a messenger gets near the camp of a tribe he has been instructed to summon, he waits till it is evening, and then approaches it quietly and swings his bullroarer. When the old men hear this they commence to sing "Birr! birr!" and go to the messenger and conduct him to the men's camp. He briefly tells them where he has come from, and postpones the rest of his message till the following morning.

Next morning he goes with the chief men to the *lóata*, or private meeting-place of the men, and there he produces his emblems of authority and hands them to the head men. If, as is generally the case, they are all agreeable to join the Burbung gathering, they accept the emblems, and the messenger goes back to the head man who sent him and reports the result of his mission. When the time arrives to start for the appointed meeting-place, all the men, women and children are mustered up, and the journey is commenced towards the Burbung ground, dances and songs being indulged in at the various camping-places along the route. When this concourse arrives almost in sight of the main camp, a stoppage is made, to give them an opportunity for preparing to meet the people already assembled there. Their

* In some parts of the district there is only one heap of earth in this circle, with a fire burning on top.

baggage is laid down, and the men approach the small ring in single file, their bodies being painted in squares and ovals in white and red colours. They generally arrive in the evening, but sometimes early in the morning. They enter the ring and go round in single file till they are all within it, and sit down on the embankment, with their faces towards the country from which they have come. One of them now sounds a bullroarer,* and the men belonging to the ground, who may be called the "hosts," then come along the track from the camp and also enter the ring and walk round, keeping inside the strange men who are sitting on the bank. Here they come to a stand, each man looking towards the big ring. The hosts know what district the new mob are from by the direction in which their faces are turned, and the new mob know the hosts are the people belonging to the ground, because they stand looking in that direction—but neither party speak a word.

The new men then get up and walk round the hosts, and start away along the track towards the urfanbang. Each man breaks two small boughs, one of which he carries in each hand, and sways them in the air at intervals as he walks along. Some of them may carry a boomerang in one hand, and a bush in the other. On arriving at the ring, they find the women of the hosts dancing within it, and the new men enter it and dance round the women. Everybody, men and women, then come out of the ring.

The women of the strangers, who had walked on to the larger ring when their men went to the small one, are sitting down outside the embankment, waiting. When the hosts' women come out, these new women, accompanied by the novices of their tribe, enter the ring. The men of the hosts, who have followed the other men from the small ring, and also carrying boughs in their hands, then march in round them. The strange women then come out, and their men go in. The men of both tribes, being now all in the ring, pull the leaves off their green boughs and throw them in the air, letting them fall on the ground, at the same time calling out the names of the principal places, Burbung grounds, etc., in their country. After this, all the men come out

* Sometimes the arrivals take place in the very early morning, at or before daylight, and the hosts are roused out by the sound of the bullroarer at the farther ring.

of the ring, and the new mob of men and women go and pitch their camp. If they had left any baggage behind when they came in sight, they would go back and bring it up. The novices, if any, in the new mob go with the women. The fathers of the novices have a mark of red paint on their foreheads or faces, so that the men at the camp may see them, and by this means learn at a glance how many new boys have been brought in this contingent. If a man have two sons to be initiated, he will have two marks on his face.

Taking away the Boys.—Early in the morning which has been decided upon for taking the boys away, the head men proceed to the sacred ring and hold a discussion as to the most convenient place to remove the main camp to. The place proposed by the tribe which has brought the greatest number of boys is generally agreed upon, provided it is otherwise suitable. When this point is settled, they all go back along the track in single file to the large ring, from which they disperse to their several camps. All the women and children are then gathered up close to the ring, and the painting of the novices is proceeded with.

The men who are to take charge of the ceremonies in the bush go away again to the small ring and paint their bodies jet black with powdered charcoal, or the bark of certain trees charred in the fire. The two men who are to use the bullroarers also see that the strings of these instruments are in good order.

The painting of the novices is done by the mothers and sisters of each boy. He is painted all over with red ochre and grease; even the hair of his head, and also his rug, are painted red. One of the novice's male relatives then comes forward and fastens a belt around his waist, to which are attached two tails or kilts, one before and one behind. He is then conducted into the ring, and is placed sitting down on the embankment—the boys of each tribe being placed by themselves on that side of the ring which is nearest their own country. The mother and sisters of each novice are just outside the embankment, sitting in such a position as just to be able to touch him with their feet. All the women and children are told to lie down and keep still, and are then covered over with rugs and bushes, which had been cut and placed in readiness for the purpose.

One of the head men now goes along the group of boys, bending their heads down, and throws a rug over each boy, so that they can only see the ground at their feet. The sound of the bullroarer is then heard in the direction of the smaller ring, and it quickly gets nearer. Two men are engaged in this duty, one on each side of the pathway connecting the two circles.

The guardians now step forward and lead the boys away out of the ring, and away along the track to the beginning of the marked trees, where they are placed lying on the ground, the group of boys belonging to each tribe having their heads pointing in the direction of their own country. In some instances the heads of all the novices are in the direction of sun-set. Here they are covered over with rugs, and are kept about a quarter or half an hour, till the women depart from the large ring, as will be described presently.

The boys are then helped to rise, and the rugs are adjusted over their heads in such a manner that a small opening is left at the face, the rug projecting at each side like a hood. This is done in order to prevent the boys from seeing anything except what is straight in front of them. One of the men then pretends to see a locust or bird, or something of the kind, in the air in the direction of the sun, and requests the boys to try if they can see it. Having looked intently for some time, their eyes are so much dazzled by the glare of the sun that they cannot see anything distinctly for a good while afterwards, and everything around them has a strange appearance.

While their eyes are suffering from the effects of the sun's rays, the guardians take them along the track and show them everything marked on the ground and on the trees. When they come to each marked tree, the men stoop down and scratch the loose leaves away from its base, and rub their hands upon it, at the same time inviting the novices to take particular notice of the moombeera cut upon it.

Removal of the Main Camp.—I must now return to the women who were left at the large ring. As soon as the novices were out of sight, the rugs and other coverings were taken off the women and children by some old men who remained in charge of them, and they were told to rise to their feet. On looking at the

deserted ring, the mothers and sisters of the novices generally feel very tristful, and vent their feelings by crying.

All the women and children, and such of the men as have remained with them, pack up all their moveables, and prepare for a start to another camp, the site of which had previously been fixed by the head men after discussion among themselves. Before leaving the camp, they fix a mark as a guide to any other tribes who may not have yet arrived. This is done by inserting a pole, eight or ten feet long, upright in the ground inside of the ring, the top of it being ornamented by having a bunch of leaves tied to it. On the shaft of this vertical pole, about four or five feet from the ground, another pole or stick about three or four feet long is lashed to it at right angles, pointing in the direction of the new camp. If there be a turn in the way leading to the latter, a stick having a corresponding bend in it would be used for the horizontal pole; and if the way to the new camp passed over creeks, their position would be indicated on the horizontal pole by means of pieces of stick tied across it, equal in number and in relative positions to the creeks to be passed over.

A somewhat similar guide is left by the men at the small ring. They cut a pole, which may consist of a tall sapling growing near about twenty feet long, and lean it in the low fork of another sapling, perhaps six feet high, in such a way that the elevated end points in the direction in which the boys were taken into the bush, the other end of the pole resting on the ground. Close by this slanting pole they also make marks on the surface of the ground, by means of small poles or sticks laid horizontally round a centre, representing all the tribes who are present—one of these sticks pointing in the direction of the country from which each tribe has come. Those tribes which have not yet arrived are not represented, but a space or opening is left where their pole ought to be. This index is called *aradna*.

Having made these preparations, the men, women and children proceed to the site chosen for the new camp, which is called *Ahrowang*. The people of the local tribe are the first to select their quarters, around which the other tribes take up their respective positions, each in the direction of the country they have come from.

A short distance from this main camp a piece of level ground is selected and cleared of sticks and loose rubbish, and in the middle of it two fires are lit, about twenty yards apart. This place is called *Aychowal.* Around these fires the mothers and sisters of the novices dance every evening accompanied by all the women and children of the tribes present. None of the men participate in these dances at the Aychowal. The last night before the boys are brought back the women dance and sing around these fires nearly all night.

The morning following the establishment of this new camp, one of the old men, accompanied by one or two of the elder women, pay a visit to the original camp. The man goes to the small ring and cuts a nick in the long slanting pole already described, to show that all the people have been gone away one day. One of the women also marks the upright pole at the large ring with one nick, conveying the same meaning. The nick cut by the man is horizontal, that cut by the woman in the other pole is vertical, the women not being allowed to mark their pole in the same way as the men mark theirs. This marking of the poles would be continued for some days, until the tribes expected had either arrived, or it was thought they did not intend to be present.

I will now endeavour to explain the use and meaning of these poles:—It sometimes happens that a tribe may be delayed on the road by rain or floods, or other causes, and arrive a day or two after the boys have been taken away. On arriving at the main camp and finding it deserted, the initiated men would all proceed to the small ring, and the women, novices, and children to the large one, where they would see the poles erected, letting them know how many days previously the main mob had left. The sticks laid upon the ground, radiating round a common centre, would let the men see what tribes were present, and also what tribes, if any, are still missing. They would then add another stick, pointing in the direction of the country they had themselves come from. The men would then go from the small ring along the track, looking at everything as they went, and join their women and boys at the other ring. All of them would then start in the direction indicated by the poles, and on coming up to the new camp they

would march into the side nearest their own country and erect their quarters. The men who had remained with the women at the new camp would go over to the new mob of men and tell them all the particulars of the Burbung, and the women of the new tribe would also enter into conservation with the other women. After awhile some of the men of the new mob would perhaps wish to start out to the bush for the purpose of joining the mob who had charge of the novices, and if they did not know the country one or more of the other men would go out with them. If the new men are well acquainted with the country, a number of them might start into the bush from the small ring, in the first instance, in the direction indicated by the pole, and let their women and the rest of the men go on to the new camp as just stated. In either case these men would join the people in the bush as described at page 123.

Ceremonies in the Bush.—When the boys have been shown all the moombeera, they are conducted to the small ring, and march once round it, and then a start is made for the bush. All the men who go with them are painted black all over with powdered charcoal as already stated.

On the journey into the bush, the boys walk with their heads down alongside of their guardians. By the way the *endahmaran* play, for the amusement of the boys, is gone through. It consists of a number of men climbing into the branches of a tree and catching on with their legs, hang head downwards, in imitation of flying foxes. The first night they form a camp in the bush consisting of a yard in the shape of a horseshoe, made of boughs or bark, with two fires in front of it, and beyond these a space is cleared. They remain here about three nights, games being played on the cleared space on the other side of the fire every night. Bullroarers are occasionally sounded during the evenings by one of the men. These games consist of imitating the opossum—making a noise like that animal—the wombat, rooting the ground and turning logs and sticks over—the bandicoot—the wallaby. During the day the men go out hunting, the boys remaining in the camp with their guardians.

At this camp a small quantity of human excrement is given to the boys, and occasionally they have to drink urine out of a coolamin. If a boy wants to micturate the first night, he must

do it in the rug he is lying in; next night he is allowed to micturate in one of the fires; and the third and last night he does it in the other fire. He must communicate his wish by touching his guardian, who then helps him to his feet and leads him to the fire.

Having remained here the required time a shift is made early in the afternoon to another camp, the boys being conducted by their guardians in the same manner as before. This new camp is formed in the shape of the letter V, the apex pointing in the direction of the women's camp. It is formed of bark or bushes according as to whether the weather is wet or fine. There are two fires in front of it, like the last camp, and a clear space beyond the fires for a corroboree ground. Besides the two fires for corroborees, the men and boys may have several other fires close to where they are lying, to keep them warm during the night or day. This camp is called *Rooingat* or "playing place." The plays represent pheasants scratching the rubbish into heaps, wonga pigeons, wild turkeys, kangaroos, fish, bears, iguanas, bees.

The men and boys camp round inside the V-shaped wall, and when the play is going on at the other side of the fire the boys are placed sitting in front of it, so that they can look at the men playing. During the day, the men go out hunting to obtain food, the boys remaining lying or sitting in the camp, some of their guardians being present all the time. In the evening the guardians and other men prepare food for the novices by removing all bone and sinew from the flesh while it is being cooked. If a boy wants to micturate he does it in one of the fires the first time, and in the other fire the next time, alternating between the two fires. If he wants to evacuate, he is taken out by his guardian a few yards from the camp, and the matter covered over when he is done. During every night of the sojourn of the boys in the bush, the bullroarer is sounded by one of the men somewhere out of sight.

When the men have been at this camping place a few days, some men, *goomat*, meaning dingo, come from the women's camp (*Ahrowang*). When these men get near the Rooingat camp, they commence cooeeing in imitation of the dingo, or native dog, and are answered by a shout from the camp. When

they get in sight they form into single file and advance in a line. Each man has a bush which he holds in front of him, so as to hide the upper part of his body. The boys are helped to get up and are stood in a row between their camp and the fires. When the goomat men reach the camp, they come round one end of it, and form a row on the opposite side of the fire to that on which the boys are standing. They then throw down their bushes and dance for a brief time before the novices, and then go into the rooingat camp and sit down. The rooingat men then go out, and, picking up the bushes brought by the goomat, strip all the leaves off them, dancing and making a great noise by shouting "Wah! wah!" all the time they are breaking off the leaves.

Some of the goomat men remain with the men in the bush, the others return to the women's camp. Those who intended remaining had painted themselves jet black on the way out, but those who intended to return were not painted. These goomat men reach the bush camp about the middle of the day. More than one lot of goomat men may visit the camp in the bush, and the formalities observed on each occasion are the same.

When it is determined to remove from the rooingat camp, the wall at the apex of the V-shaped enclosure is thrown down, and the men and boys march out through the breach and proceed in the direction of the women's camp to another place, where they erect a camp all in one line. Only one night is spent in this camp, and the men remain up nearly all the night, playing different animals and singing. Next morning the men form a semicircle, dancing in front of the boys, who are put standing in a row, and two men step into the clear space and swing bullroarers. The blankets are then lifted off the heads of the novices, and they are told to look. The chief men then advance, and, stepping up quite close to the boys in a menacing attitude, threaten them that if ever they divulge anything which they have seen or heard in the bush, they will lose their lives either by the hands of their fellows or by supernatural agency.

After this all hands remove from that place, still going towards the women's camp, till they come to a water-hole, where a halt is made. On the way from the last camp to this place, the novices have been allowed to carry their heads erect and look about them.

The men play the crow, imitating that bird, and then play the dingo, scratching back dirt with their feet. After this all the "black" men go into the water and wash the black paint off themselves; the guardians also go in, but the novices sit on the bank watching them. When the men come out of the water, they singe the hair short on the boys' heads, and also off other parts of their bodies; the hair of the men is not singed. Everybody, including the boys, then paint themselves white with pipeclay, which is diluted with a small quantity of water in a *coolamin*. The men and boys assist each other in this painting, which must extend all over their bodies, including the hair of their heads. The whole party being now painted with pipeclay, may for distinction be called "the white mob." If there are any dogs in the party, they have a white streak of pipeclay marked down their forehead to the point of the nose. The men and boys now catch hands and form a ring, to see what space they will occupy, being a kind of drill so that they may know their work when they reach the women's camp presently.

The shrill, cooeeying sound of the goomat men coming from the women's camp is now heard, and one of the white men swing a bullroarer in reply. The novices are placed standing in a row in a clear piece of ground facing in the direction of the women's camp. The goomat now advance in single file, each man carrying a bough in front of him as before described, and form a line facing the novices. The goomat men now throw down their bushes and go through a short dance. The "white" men step forward and pick up the bushes which the others have thrown down and pull the leaves off them, scattering them about, making a great noise, as previously described.

The head man of the goomat mob now asks the "white men" to form into a ring by joining their hands, in order that he may see the size of the ring, for the purpose of assisting him in placing the women round the fires. The goomat men now take their departure and return to the women's camp at the Aychowal.

When the mob started out to the bush to meet the men and boys at the water-hole, the women replenished the fires and cut a number of green boughs, which they laid in a line between one fire and another. On the return of the goomat all the women and children are mustered by the men and are placed lying down

outside the fires, and are then covered over with rugs, blankets and bushes. A few of the head men of the camp mob remain standing round the fires watching the women.

Return of the Boys.—When all is ready the "white mob" make their appearance in single file, the boys and their guardians being in the lead—a guardian being in front with his novice behind him, then another guardian followed by his novice, and so on. Before coming in sight of the camp they laid down everything they were carrying, and now have nothing in their hands. A large bullroarer, Boolpee, would be sounded in the rear by one of the goomat men as this mob approached. This would be about the middle of the day.

When the front man gets within such a distance of the point midway between the two fires as he estimates to be the radius of the circle, he turns to one side and the others follow him. When about half the mob have gone to this side, the men who are still coming turn the contrary way, going round to meet the first man. When all the men and boys are in their places, they catch each others hands and form a complete circle which may be called the "white ring," round the women and the fires. They do all this as quietly as possible, so that the women may not hear them coming in. Some of the goomat men are standing outside the "white ring" directing the proceedings, having estimated the size of the ring by having seen it formed at the water-hole in the bush.

The head men now give orders for the women to get up, and each mother then looks around for her son. Having his hair cut off, and being painted white, sometimes so alters his appearance that his mother cannot readily recognise him. Some of the goomat men perhaps indicate the son's position. Each boy has a nose peg made of kangaroo bone through the septum of his nose, or carried in his mouth, to further assist in distinguishing them from the other men. Each mother goes close to her son, and catching one of her breasts in her hand raises it towards him, and he bends his head and pretends to suck it. The sisters of the novice also approach him, and rub their feet on his feet and ankles. The mothers then rub their hands on their sons, and on all their male relations, pretending to rub the white paint off. Every man in the "white ring" will be rubbed in this way, after

which the mothers and all the women pass out of the ring under the men's arms, and stand a few paces away to witness the remainder of the performance.

The men forming the "white ring" now close in, and commence throwing the bushes on the fires. They commence midway between the two fires and take the bushes each way, some being thrown on one fire and some on the other.* The boys do nothing. Each guardian, assisted by the men near him, then lifts his novice in his arms, and holds him in the smoke arising from the smouldering of the green bushes. Half the boys are smoked at one fire and half at the other. While the men are holding the boys up in the smoke, the former keep repeating "Birr! birr!" and the women exclaim "Heh! heh!" The guardians and other men stand on the bushes and the smoke ascends around them and the boys. As each novice is held up by his guardian, he shakes his breast.

As soon as the novices are smoked they catch each other's hands and run away to the place where the swags were left when approaching the camp shortly before. The signal for them to run away in this manner is when they hear the men clapping their hands. When the women hear this clapping they turn their backs so that they will not see the boys running away.

The guardians go after the boys, and some of the other "white" men follow them a short distance and return to the fires. The smoking ceremony is then completed, and the "white" men go back to the place where they left their swags, and bring them into the main camp. The guardians and boys remain where the swags were left all night. It is only the men and boys who were out in the bush, whom I have called the "white mob," who are smoked; the Goomat and other men belonging to the women's camp are not smoked, but are standing around assisting the head men in carrying out the various formalities.

Next day a lot of rugs, equal in number to the novices, are laid in a line on the ground, and two coolamins of water are placed alongside. The mothers of the boys and all the women are close by this, and as the guardians approach with the boys the women commence shouting, "Heh! heh!" and throw pieces

* One fire only is used at the Aychowal in some parts of New England.

of bark at them, which the guardians ward off. The boys are conducted to the rugs and sit down upon them, and the guardians give them a drink out of a coolamin. The guardians and novices then go back to their own camp, and the women return to theirs. Any of the men who were present also go back to their respective camps.

Final Ceremonies.—On the following morning, the strange tribes who are present make preparations for taking their departure, and in the course of a few days they are all on their way back to their own hunting grounds. The remainder of the initiatory rites are completed by each tribe upon their own boys when they get back to their respective districts. On their way thither, they are not permitted to come near the women or children, but are kept by themselves in the custody of their guardians. As these final ceremonies are the same for each tribe, the details relating to the local mob only will now be stated.

In about a week's time after the meeting at the Aychowal fire, the boys are brought, all marching abreast, to a place where the men have lit two fires similar to those at the "white ring," but in a different place, and none of the men are painted, except the boys, who are adorned with white and red stripes crossing each other, forming squares. Rugs are spread upon the ground, and the boys are brought in and seat themselves upon them. The men then form a ring round the boys and join hands, as at the Aychowal ring. Food is then placed before the boys, and the guardians remain standing by while they eat. When they have had enough they are again smoked, but on this occasion they stand on the ground on the leeward side of the fires, after which they go away to their camp accompanied by the guardians. The ring of men then breaks up. If there is any remaining food, the guardians take it with them to the boys' quarters. When these proceedings are over, the women return to their own camp, which is not far away. The men then put bushes on the fires and jump upon them, the smoke ascending round them as at the former ring.

From the time the boys started away from the Aychowal ring till their return to the present meeting place, they were obliged to carry a firestick in their hand when travelling from one place

to another; but from this time forth they are freed from carrying the fire. They are, however, kept under the surveillance of their guardians for some time yet, during which they must abstain from certain kinds of food enumerated by the old men of their tribe. The novices must not let a woman's shadow fall upon them, or on their weapons, or anything worn by them. This shadow is called *tawanba*, and is superstitiously avoided.

Conclusion.—In the preparation of this article I have been obliged to deal only with the most important parts of the ceremonies, and to abridge my descriptions of them as much as possible, in order to keep the paper within reasonable limits for publication; but it is hoped that the details will be found sufficiently full for ordinary purposes of comparison with similar rites celebrated in other parts of Australia.

The extraction of a front tooth has not been practised by the New England tribes for many years, and as there appear to be grounds for doubt as to whether the custom was ever in force in some districts of New South Wales, any further remarks on this part of the subject will be deferred until additional investigations have been made. It may be stated, however, that the whole of the interesting ceremonial in connection with the knocking out of a tooth, as practised by several native tribes with which I am acquainted, has been particularised by me in other publications.

Lying between the eastern margin of the Tableland of New England and the Pacific Ocean is a large tract of country, extending from about the Hunter River northerly along the coast as far as the Clarence, peopled by a number of tribes differing more or less in their dialects, but having substantially the same class system. The initiation ceremony of these tribes is known as the *Keeparra*, which is of the same type as the Burbung herein described, all the essential points being almost identical in both, although many of their details differ considerably. It may, therefore, be said that practically the ceremonies described in this paper represent those in force in the whole of the country between New England and the sea coast.

As before stated, the New England tribes are bounded on the west by the Kamilaroi, whose *taurai*, or country, extends down the Severn, Macintyre, Gwydir, Namoi, and other rivers to their

junction with the Barwon, and still farther to the westward. The *Bora*, or initiation ceremonies of the Kamilaroi tribes, is described in a paper contributed by me to the Royal Society of Victoria.* Although the extent of country occupied by the tribes of New England is comparatively small, their ceremonies are of great importance, as affording a connecting link between the Keeparra on the one side, and the Bora on the other; a modification of portions of both these ceremonies being observable in some parts of the Burbung described in this article.

* Proc. Roy. Soc., Victoria, vol. ix., (N.S.), p. 137.

Art. XI.—*The Bora of the Kamilaroi Tribes.*

By R. H. Mathews,

Licensed Surveyor.

(Communicated by Professor Baldwin Spencer).

[Read 10th September, 1896.]

The Bora at Tallwood.—In March, 1895, I heard that the aborigines were mustering near Tallwood Station, on the Weir River, Queensland, for the purpose of holding a Bora. By corresponding with residents of the district, I learnt that, owing to the very dry weather, great delays arose in gathering the various tribes who intended to be present. In June, fearing to put off my visit any longer, lest the ceremonies should be commenced before I got there, I started for the scene of the Bora. This journey was accomplished by going 350 miles by railway to Narrabri, and thence by stage coach 150 miles to Mungindi, a small town on the boundary between New South Wales and Queensland. At Mungindi I obtained a horse and sulky and drove an additional distance of 55 miles to the aboriginal camp on the Tallwood run, making a total distance of upwards of 550 miles. The only people then assembled at the Bora ground were the local Tallwood tribe and the contingents from Kunopia and Welltown respectively.

After I had pitched my camp, I entered into conversation with the head men, some of whom were known to me, having been acquainted with them when surveying Crown lands in that part of the country in 1875 and 1876. I had been kind to them in those days, while listening to their legends and their songs, and studying their wonderful class system*; and when I met them now I found their friendship of the greatest value to me. On my showing them that I knew their Bora secrets, they received me as one of the initiated, and admitted me to all their secret meetings.

* See "The Kamilaroi Class System of the Australian Aborigines," Proc. Roy. Geog. Soc. Australas., Qld. Bch., x., 18-34.

I was disappointed on learning from these natives that some of the most distant tribes had not yet arrived, although weekly expected, and that the final ceremony could not take place until they came. I then determined to wait at the camp a few weeks in the hope of their arriving within that time, and at once set about taking measurements and drawings of the circles and the pathway connecting them, the warrengahlee, and as much of the yammunyamun on the trees and on the ground as I considered necessary. The position of the main camp and its surroundings were also noted.

I spent the greater part of my time with the head men, asking them to fully describe every part of the ceremonies, which I took down in detail in a note-book which I carried for the purpose. On several occasions I took about a dozen of the initiated men, and one or two of the chiefs, with me into secluded parts of the forest, a mile or two from the camp, where I got them to reproduce most of the several parts—mimic performances, spectacular exhibitions, and tableaux, which are enacted in the daytime, while the novices are away in the bush with the kooringal. They also performed the greater part of the dances and plays which take place at the camp fires at night on those occasions described farther on in this paper, when the novices are brought out of their own yard for the purpose of being present at them. All the performances which were gone through in my presence agreed exactly with the descriptions of them which I had previously obtained from other blackfellows at the camp, and elsewhere in the district.

I remained at Tallwood between two and three weeks, and during this time the tribe from Goondiwindi and that from St. George, severally put in an appearance, and were welcomed in the usual manner* ; but the Mogil Mogil, Gundabloui and Mungindi tribes had not yet arrived ; and from letters which I had received from correspondents at the last-named place, there was no probability of their coming for another month or more, owing to the arid state of the country, and the consequent difficulty of obtaining food and water.

As I could not possibly spare the time to wait so long as that,

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* Journ. Anthrop. Inst., xxv., 321-325.

I returned to Mungindi, where I learnt that the local tribe were gathered on the Barwan River, not far away, and that the Gundabloui and adjacent tribes were camped at Gnoolama, on the Moonie River, about eighteen miles distant, waiting for rain to enable them to proceed to Tallwood. I therefore visited these tribes, and spent another fortnight gathering all the details I could regarding their initiation ceremonies and other customs. There I met Moogan Billy, Jack Bagot,* and other head men with whom I had become acquainted when I was camped at Mungindi in 1880, surveying that township for the Queensland Government. They welcomed me as an old friend, and cordially gave me all the assistance they could.

It was now the end of July, and there being still no rain, or any probability of the tribes referred to making an early start for the Bora camp at Tallwood, I decided to leave the district. Before starting away, I arranged with a gentleman living in the district to furnish me with the date of the arrival of the last contingent at Tallwood, and of the breaking up of the Bora camp. I also asked one of the old blackfellows, as a personal favour to me, to tell my correspondent the place where the novices were taken during their sojourn in the bush, as well as the location of the Thurrawanga camp, to which the kooringal and their charge returned. This was all the additional information I required, because I had already collected complete details of the secret ceremonies which would be conducted in the bush. My sable friend faithfully kept his promise, and from the information which he subsequently supplied to my correspondent, I have been enabled to add particulars respecting the date of the commencement of the principal ceremonies, and the position of the secret camp in the bush.

On the 1st of September a small detachment of men and women belonging to the Gundabloui, Mogil Mogil, and Mungindi tribes arrived at the Bora camp, and were accorded the usual reception. These blacks had been sent to represent the tribes to which they respectively belonged, the rest of their people remaining at Gnoolama, before referred to, as they did not care to undertake the journey to the Bora ground owing to the severe

* Journ. Anthrop. Inst., xxiv., 411.

drought then prevailing throughout the district. A few natives from Meroe also arrived at Tallwood on the same day as the Gundabloui contingent.

As the water in Redbank Creek, on which the main camp was situated, was rapidly drying up, no time was lost in proceeding with the ceremonies after the detachments referred to had arrived. Accordingly, on the 3rd of September the novices were taken away from the large ring in the manner subsequently described. The men and novices then proceeded to Gurardera Lagoon, about nine or ten miles in a west-south-westerly direction from the Bora ground. This lagoon is on Gurardera Creek, about two miles above its junction with Warrandine Creek, and was the only place for several miles around where there was water. Here a camp was formed, and a boughyard erected for the boys about eighty yards from the men's camp. A description of the shape and structure of this yard, and the general arrangement of the men's quarters, will be found in subsequent pages.

The boys were kept at this camp for nine or ten days, during which the various performances, described under the head of *Ceremonies in the Bush*, were enacted at the camp fire, and while out hunting during the day. At the end of the time mentioned, the *Kooringal* met the *Beegay* in the bush, and after the boys had been shown the bullroarer, they all proceeded to a water-hole in Warril Creek, where the kooringal and guardians washed themselves and camped for the night. The following morning the boys were taken to the thurrawanga. Details of all the matters briefly referred to in this paragraph will be given farther on. My correspondent, under directions from me, also gave me very full measurements and sketches of the thurrawanga camp, from which I have been enabled to prepare the description of that camp given elsewhere in this paper.

The tribes who attended the Tallwood Bora were for the most part the same people who had assembled at Gundabloui* a little more than a year before, and all belonged to the Kamilaroi community and had the same class system. The tribes from Goondiwindi and Welltown spoke Pickumbil, the St. George

* Journ. Anthrop. Inst., xxiv., 411-427; *Ibid.*, xxv., 318-339; and Journ. Roy. Soc. N. S. Wales, xxviii., 98-129.

people spoke Kogai, and the Kamilaroi language was spoken by all the rest; but these three dialects appeared to be mutually understood by most of the people present. There were twenty-four novices initiated, five of whom were half-castes.

Gathering the Tribes.—Messengers were despatched by the headman of the Tallwood tribe to all the people whom he wished to be present at the ceremonies. These messengers were of the Kupathin class, and totem emu, the same as their chief, and were sent to men of the same totem in the other tribes. Each messenger carried with him a bullroarer, several kilts, and other articles, and was accompanied by a novice painted red from head to foot. There was also another man with them, who acted as guardian to the novice. The formalities observed on the arrival of the messengers at a strange camp, and also on the arrival of a tribe at the Bora ground, were practically the same as previously described by me.* I was at Tallwood when some of the contingents arrived, and was present at the reception at the large ring to which the men, women and novices proceeded on their first arrival. I was also permitted to accompany the men over the sacred ground, visiting the figures of Baiamai and his female consort, the yammunyamun, and the imposing spectacular display at the goonaba, where the two old head men, having their bodies smeared all over with human blood, stood upon the warrengahlee while the men approached them swaying pieces of burning bark wrapped in green bushes, from which the smoke curled upwards into the air.

The General Encampment.—The camp was situated on level ground in some heavily timbered forest country on the left bank of Redbank Creek, a small tributary of the Weir River, in the Parish of Tallwood, County of Carnarvon, Queensland. This place is about four miles northerly from Tallwood, an old head station on the main road from Goondiwindi to Mungindi. The camp of the local tribe, which was the first to occupy the ground, was about seventy yards from the creek, and formed the datum point around which each of the other tribes pitched their camps on arrival. The Goondiwindi and Welltown people camped to the eastward of the local Tallwood tribe; those from St. George on

* See Journ. Anthrop. Inst., xxv., 319-327.

the north-west; the people from Kunopia and Meroe on the south; whilst the Moogan, Mungindi and Gundabloui tribe encamped on the south-west. Water for camp use was obtained from a waterhole in Redbank Creek, and game of various kinds was sufficiently abundant in the extensive scrubs to the north and west of the camp, to provide sufficient food for the people while the ceremonies lasted. From the camp to the nearest part of the Weir River was about two miles.

The total number of people of all ages and sexes assembled at the Bora camp was about 150, the greater part of whom belonged to Queensland; but the New South Wales boundary, the Barwan River, being so near, a number of the natives of the latter colony were also present.

An unusual event happened at this camp which adds to its interest. The local tribe first selected the site of the camp on the southern side of Redbank Creek, and the Kunopia contingent afterwards came and pitched to the southward of them. Before any of the other tribes arrived one of the young men of the local tribe died from some pulmonary complaint, and according to custom this necessitated a removal of the camp. As the Bora ground had then been formed, the choice of a new site for the camp was restricted to the other side of Redbank Creek in order to be near the water-hole.

The Bora Ground.—The site selected for the performance of the ancestral rites, or "Baimai's Ground," was situated in a forest of box, sandal-wood and undergrowth, about fifteen chains in a south-westerly direction from the general camp, on the other side of Redbank Creek. The soil consisted of reddish sandy loam, known among bushmen as "umah country." This kind of ground is very suitable for the purpose of forming either carved or raised figures on its surface.

In a small, naturally open space on the edge of the scrub, a large ring, 77 feet 6 inches across one diameter and 72 feet across another at right angles to it—which would give an average of very nearly 75 feet—was formed by scraping away the surface soil, which was used to form an annular mound or embankment, about eight or nine inches high, and a foot wide at the base, around the space thus cleared. An opening about two feet wide was left on one side of this bank, from which ran a narrow track

called *thunburran*, made by scraping the surface of the ground smooth and throwing the loose earth on either side. The bearing of this track was N. 62° W., and in following it in this direction for 270 yards, it was found to terminate at another and smaller circle, called *goonaba*, 47 feet in diameter, bounded by a circular bank, composed of loose earth, about five or six inches high. The track, *thunburran*, entered this enclosure through an opening in its wall similar to that in the other circle. Within this ring, and near the farther side of it, were two stumps of trees, which had been prepared in the following manner. Two small trees had been dug out of the ground by the roots, and their stems then cut through between six and seven feet from the base, all the bark being stripped from the stem and roots. These stumps were then carried to the *goonaba*, and holes were dug, into which the stems were inserted and the earth filled in tightly around them, leaving the roots at the top, some of which extended outwards about four feet, and were ornamented with narrow strips of bark twisted round them. These stumps, called *warrengahlee*, one of which was belar and the other coolabar, were twelve feet apart and five feet five inches out of the ground, the stems and roots of both being smeared with human blood. The blood for this purpose is obtained by making small incisions, with a piece of sharp flint or shell, in the arms of several men, and collecting the blood in vessels as it drips from the wounds.

Scattered over the floor of the *goonaba*, between the *warrengahlee* and the entrance of the thunburran (track), were a considerable number of small heaps of loose earth, each having a short stick inserted perpendicularly in the top. When welcoming a new contingent of natives, these heaps are flattened down during the ceremonies, as described by me elsewhere,* but are restored for use on all similar occasions. After the arrival of the last mob of natives who have been invited, the heaps are not again erected.

I will now endeavour to give a full description of the imagery displayed upon the ground and on the trees throughout this sylvan temple. Starting from the larger circle, which is

* Journ. Anthrop. Inst., xxv., 324-325.

called *boora*, and proceeding along the track it was found to enter the scrub almost at once; and at the distance of eighty-seven yards on the right hand side there was the representation of a bower bird's "playhouse," consisting of a collection of small pebbles, fragments of bone, and the seeds of some wild fruits.* Three yards farther on, also on the right, there was an effigy made by filling an old pair of trousers and a coat with grass so as to resemble a man, a bundle of something being used for the head. This figure was then propped up against a small tree and represented a white fellow.

The carvings on the soil, *yammunyamun*, commenced at the distance of ninety-six yards from the large circle, and thirty-four yards farther, close by the right side of the track, was an imitation of a bullock lying down, formed by pieces of bark covered with loose earth, having the dry bony skeleton of a bullock's head laid on one end of it, and a bent stick stuck in the other end for a tail.

At a distance of 143 yards from the starting point, on the right side, was a horizontal figure of Baiamai, outlined by heaping up the loose earth, which was one foot two inches high at the chest. The length of the figure was nine feet six inches, and the width from hand to hand nine feet. On the opposite side of the track was an image of Gooberangal, the wife of Baiamai, formed in the same way, but with the addition of a coat of kneaded clay on top in which were moulded the features of the face, the mammæ and the pubes. The length of this figure was ten feet nine inches, with a distance of eight feet between the hands.

Twenty yards farther on than the preceding, on the left, was the representation of an emu with its head towards the large ring, outlined by a nick, or groove, between one and two inches deep, and about two inches wide, cut in the soil by means of tomahawks and sharpened sticks; its length from the bill to the tail being twelve feet six inches, and its height from the feet to the top of the back seven feet nine inches. The legs are short in proportion to the body, being only two feet six inches long—perhaps to indicate that the bird is sitting or crouching down.

* The bower-bird builds its nest in a tree, but forms these "bowers" or "playhouses," as they are called by bushmen, on the ground in the way described.

Three yards farther on than the emu, on the opposite side of the track, was the *Goomee* or Baiamai's fire. The loose earth had been heaped up about a foot high like a large ant-hill, on the top of which the fire was lighted. Around this heap there was a clear space about thirty feet in diameter, which was used by the men as a place of assembly when they wished to deliberate upon matters of tribal concern, as well as on the occasion of the arrival of other tribes.

Eighteen yards beyond the *Goomee*, on the same side, parallel with the track, a codfish nine feet long and three feet eight inches across the body was outlined by a nick in the soil, its head being towards the goomee. This drawing has a characteristic resemblance to some of the figures of fish which I have seen carved on rocks* on the Hawkesbury River, New South Wales.

A little farther on the same side as the preceding was the carving of a large snake, representing the Currea, a fabulous monster inhabiting lagoons and other sheets of water. This animal was lying parallel with the track, with its head towards the larger ring; its length was thirty-nine feet, and its greatest width about a foot.

On the other side of the track and parallel with it, opposite the last figure were two death adders formed of raised earth, their heads and tails being together, the former in the direction of the large ring. The length of each was a little over sixteen feet.

About fifteen yards farther on, on the same side, were two other figures of death adders, also formed of raised earth, with their heads in the same direction, one being nine feet long, the other ten feet six inches.

Opposite to the last two figures was a good representation of a scrub turkey's nest composed of sticks, leaves, and dirt scraped into a heap near the butt of a tree.

Ten yards farther on than the turkey's nest, or 215 yards from the large ring, near the right side of the track, was the skin of a porcupine filled with sand, having some of the loose soil piled around its feet, leaving the back exposed, a very good representation of the animal as found in the bush.

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* "Rock Pictures of the Australian Aborigines," Proc. Roy. Geog. Soc. Aust. (Q.), xi., 104-105, plate ii., fig. 13.

Fourteen yards beyond the porcupine, on the same side, was an imitation of a kangaroo rat's nest, formed of grass. After another interval of fourteen yards, also on the same side, there was carved on the ground the figure of a man with a boomerang in each hand and a belt around the waist. The object, two feet five inches long, rising from the top of his head, was, the artist told me, intended to represent a feather stuck in his hair. This figure, which was at right angles to the track, with the feet towards it, bears a striking resemblance to some of the rock pictures of the aborigines of other districts, large numbers of which have been described by me in different publications.

On the other side of the track, and at right angles to it, opposite the last described figure, was the representation of a woman, cut out in the ground in a similar manner. The eyes and mouth were delineated, but the feet were omitted. The height was seven feet four inches, but would have been more if the legs had been straight.

The imitative faculties of the natives were displayed in a few drawings, copied from scenes in the life of the white man, which were intermixed with the others. At one place an attempt had been made to represent a railway train, the carriages with their windows, the numerous wheels, and the two rails on which they were running. At another place a native artist had drawn a chain like those used when working bullocks in a dray. The links of the chain were on a colossal scale, being four feet nine inches long, and one foot three inches wide. This carving was close to the raised figure of the bullock previously described. Another draftsman, apparently a poker player, had succeeded in representing the four aces. Four rectangular spaces, about two feet long and eighteen inches wide, were first made side by side to indicate four cards, and on the middle of each of these one of the aces was delineated. All the drawing referred to in this paragraph was cut out in the soil.

Besides the foregoing figures of men, animals, and other objects, there were a large number of curious designs, which the Kamilaroi and Wiradthuri tribes call *yammunyamun*,* cut into the turf. These devices commenced at ninety-six yards from the larger circle, and

* Journ. Anthrop. Inst., xxv., 302-323.

terminated about five yards from the smaller one; thus covering, together with the first figures described, a linear distance of 169 yards, and extending back about six or eight feet from either side of the track. The *yammunyamun* filled up all the spaces between the other figures, the continuity being of course interrupted by the numerous forest trees and bushes growing within the space mentioned. The largest of these designs was thirty-seven feet in length, by seven feet in width; another was twenty-nine feet by five feet. Some of the smallest of these carvings were only two or three feet in length, filling out spaces between the trees. All the grass, rubbish and loose surface soil had been removed, and piled into heaps; and the earth cut out in carving, the outlines had been disposed of in a similar manner. A good deal of the surface soil thus obtained was used in building the images of Baiamai and Gooberangal already described. Owing to the great extent of ground covered by the *yammunyamun*, and the time and labour which would have been required in copying the whole of it, I selected as much as I thought would fairly represent the different patterns of native drawing as displayed on this Bora ground.

Scattered here and there along the track for a distance of about 175 yards from the *goonaba* were a number of trees marked with a tomahawk, the designs on most of which consisted of *yammunyamun*, somewhat similar in character to that carved upon the ground. Some of these trees were quite close to the track; others were eight or ten feet back from it on either side, and three of them were around outside the goonaba embankment.

On a forked box tree between the *goomee* and the *goonaba*, eighty yards from the latter, the crescent figure of the moon was cut through the bark, and a short distance below it were four zig-zag lines. About eighteen feet from the ground, in the same tree, was a fairly good imitation of an eagle-hawk's nest.

In another tree close by was a large bunch of boughs similar to those fixed in trees by the natives near water-holes for the purpose of concealing themselves to spear emus when the latter come to drink. This represented Baimai's hiding place when he speared the emu.

Close to the track, sixty-five yards from the goonaba, was a small box tree, along the bole of which a wavy band about two

inches wide had been cut with a tomahawk through the bark, and extending from the ground to the height of about twenty-five feet, representing a tree which had been struck by lightning.*

On a box tree twenty yards from the goonaba a carpet snake, nine feet four inches long, with its head towards the ground, was cut through the bark; and on a forked box tree near the porcupine, an iguana five feet two inches long was formed in the same way. Between the iguana tree and the goomee, a centipede three feet one inch long, with eighteen legs, was chopped through the bark into the wood of a box tree near the track. Below it were some diamond-shaped devices cut in the same manner.

This Bora ground, although containing all the principal figures necessary, was neither so extensive nor so richly ornamented as others I have seen. From circle to circle was only 270 yards, and the space containing the ground carving and marked trees was about 175 yards by a width of from fifteen to twenty feet. The old men explained to me that this was owing to their having been shorthanded when preparing the ground, which was an entirely new site. At the Gūndabloui Bora described by me in the Journal of the Anthropological Institute of Great Britain, Vol. XXIV., pp. 411-427, the distance between the circles was twenty-three chains, the length of the carved ground being 320 yards, and its width forty feet.

Old blackfellows have told me that when they were boys Bora grounds were much larger and more elaborately embellished than they are at the present time. I once inspected an old disused Kamilaroi Bora ground on the Moogan Run, Queensland, where the distance from circle to circle was more than a mile. The large ring was thirty-five yards in diameter, and was still easily traceable on the ground; my guide, who was an old blackfellow, stating that when he was a young man the height of the wall was "up to his knee." The base of the wall was about eighteen inches when new. There were, of course, then no traces of the figures which had been raised or graven upon the turf, but judging by appearances, and what my guide told me, they must have extended about a mile, and their width would probably be

* A tree struck by lightning is represented in plate xxvi., fig. 13, Journ. Anthrop. Inst., xxv., 300.

about fifty feet. In those days there were plenty of men able and willing to do the work, which was renewed and added to every time a Bora was held there.

Mr. J. Henderson, in his book, "Observations on the Colonies of New South Wales and Van Dieman's Land," published in 1832, pp. 145-147, thus refers to a Bora ground near Wellington, New South Wales :—"A long straight avenue of trees extended for about a mile, and these were carved on each side with various devices, most of which were intended to represent serpents in all their different attitudes. On the upper extremity of this the earth had been heaped up so as to resemble the gigantic figure of a human being extended on his breast, while through the whole length of this sylvan temple a variety of other characters were observed rudely imprinted on the turf. The devices on the ground bore a strong similitude to the lingen of the Hindoos. . . . . The devices on the trees represented snakes, the opossum, the emu, the kangaroo, the cockchafer, etc., while others were stated to indicate the forked lightning, warlike instruments, and falling meteors. The evil spirit seemed to be described under the form of an eagle-hawk ; an imitation of his eyrie formed a conspicuous object at the upper end of the grove. At the lower extremity of the avenue, a narrow pathway turned off to the left, and soon terminated in a circle, which was enclosed by a wall composed merely of the loose earth." In a plate appended to his work, Mr. Henderson gives drawings of some of the devices on the trees and on the ground.

The Thurrawonga Camp.—It is imperative according to ancient tribal custom, to remove the entire camp to another place after the boys have been taken away for initiation purposes.* This new camp, which may appropriately be designated the "Thurrawonga Camp," because the boughyard known as the *thurrawonga* is erected there, may be only a short distance away, or it may be several miles from the original main encampment, according to the exigencies of the case as regards food and water, or general convenience. As soon as possible after the novices have been taken away by the head men from the large ring known as the "boora," in the manner described farther on in this

* Journ. Anthrop. Inst., xxv., 330.

paper, the women, assisted by the men who remain with them, start away to the locality which has been agreed upon.

On the present occasion, the site chosen for the new camp was on the right bank of Warril Creek, about ten or eleven miles in a south-westerly direction from the main Bora encampment, and about seven or eight miles south-south-easterly from the camp of the kooringal on Gurardera Lagoon, already referred to.

On arriving at the new site, each tribe selected their quarters on the side nearest their own country, the camp of the local Tallwood tribe being the initial point. The people obtained water from a dam in Warril Creek, about a hundred yards above the camp. Every night, by the camp fires, the mothers of the boys sang bobbarubwar songs, and the relatives and other women danced.

Down the same side of Warril Creek, 496 yards from the camp, and about two chains from the right bank of the creek, the thurrawonga was erected. Forked saplings were inserted in the ground, and rails consisting of long poles extended from one fork to another, and boughs were then piled up against the rails, to form a dense fence. The shape of this partial enclosure resembled that of a horse-shoe or segment of a circle, being twenty-seven yards across the open end—the distance from there to the back of the fence being sixteen yards. The height of the fence was about four feet, and the convex end faced in the direction from which the novices were expected to approach—the open end being towards the new camp erected by the women.

Taking away the Boys.—As soon as convenient after the arrival of the last mob of natives who are expected to join in the proceedings, the head men discuss among themselves as to the date on which the assemblage shall be broken up, and the initiation ceremonies commenced. There are several matters which have to be arranged among all the head men present before this date can be definitely settled, therefore these important deliberations, which may occupy two or three days, or may perhaps be disposed of in one, are conducted at the *Goomee*, where there will be no chance of interruption. All the people proceed to the large ring in the afternoon, and go through the ordinary daily performances,*

* Journ. Anthrop. Inst., xxv., 326.

after which the women and novices return to the camp as usual, and the men proceed to the *goomee*.

One of the most important matters to be disposed of is the selection of a suitable and convenient place for the establishment of the new camp, which may be called the Thurrawonga, after the tribes remove from the Bora ground. One or more of the head men of each tribe stand out in their turn and harangue the rest of the men on the subject, giving their opinions as to the situation which would be the fairest for all. As soon as the locality is decided upon, one of the men who advocate that place advances to the fire which is burning on the goomee, and lifts a firestick, which he throws in the direction in which the new camp is to be erected, at the same time calling out the name of the locality, which is then repeated by all present, and that matter is finally disposed of.*

The hunting grounds into which the novices will be taken during the principal ceremonies of their initiation have also to be selected. As this point is so intimately connected with the situation of the new camp, the two subjects are frequently argued and decided at the same time.

Another very important matter which engages the attention of the old men is the selection of the *Kooringal*, the chosen band of athletes, who have the custody of the guardians and novices whilst the latter are going through the secret ceremonies in the bush. The old men choose the *Kooringal* from amongst all the tribes, each man selected being asked if he is willing to go; single men are generally asked, but it is not uncommon for married men to be chosen.

All these arrangements having been made, and the date fixed for the commencement of the ceremonies, some of the young men strip bark, and shape it into pieces about two feet and a half in length,† and about four inches wide at the broadest end, and two inches at the other, called Mungawan, which they place on the ground near the *goomee*, with logs of wood laid upon them to keep

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* The Kamilaroi tribes on the Lower Moonie River decide the position of the Thurrawonga Camp in a different manner, and with greater formalities. Journ. Anthrop. Inst., xxv., 327-8.

† Pieces of bark similar to these were used for the same purpose at the "Burbung of the Wiradthuri Tribes." Journ. Anthrop. Inst., xxv., 308, plate xxvi., fig. 40.

them flat, ready for use. All the men then return to the large ring and dance round within it, calling out the names of places in their country, each name being received with shouts, after which they start for the camp in single file, each class of men keeping by themselves, and shouting as they go. On nearing the camp, the novices and women join them, going into their proper class positions, and all of them dance round on the cleared space near the camp, the men of each tribe again calling out the names of a few principal places in their country. The women dance outside the men, having green bushes in their hands, from which they pluck handfuls of leaves and cast them at the men as they dance past. One or more of the young men, before leaving the fire at the *goomee*, smear their bodies with ashes, and the other men tell the women that the Evil Spirit rolled those fellows in the ashes because they did not play right.

On the day preceding that on which the assemblage breaks up, soon after the return of the men to the camp in this way, two or three of them pretend to quarrel about something,* uttering loud recriminations in order to attract attention, and stand out with boomerangs and other weapons in their hands. Some of the men and women run from all parts of the camp to see what the dispute is about with the intention of preventing quarreling at the Bora meeting. This is a well-known signal to such of the women who have attended similar gatherings that the boys will be taken away the next morning. The dispute suddenly ceases and the men run through the camp repeating Pir-r! pir-r! and the women call out Yah-ow! in response. These shouts are kept up for a short time, until the whole camp becomes aware of the order to break-up. The women raise a lamentation, because they are sorry that the corroborees and daily performances are all over.

Then everybody commences to pack up, and shortly before sunset they all start for the large ring, carrying sufficient water to last them for the night and next morning, because the ring is generally some distance from the creek, river, or water-hole where the camp is situated. They camp near the ring for the night, each tribe locating themselves in the direction of their country, and the mothers of the novices sing bobbarubwar, and beat their

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* Journ. Anthrop. Inst., xxv., 327.

rugs at their camp fires. The men go on to the *goomee*, and select the young fellows who are to use the mungawans next morning, and then return to the large ring. At night the men dance a corroboree as usual, after which the boys lie down to rest. During the evening a bullroarer is sounded at intervals in the direction of the *goomee*. Great sexual license* is permitted between the men and women, whether married or single, on this occasion, but this liberty is restricted to those parties who would be permitted to marry each other in conformity with the class laws of the tribe. This license is not extended to the novices. Some time before daylight a number of the men leave the camp, unknown to the women, and go and remain at Baiamai's fire till the morning. These are the men who have been chosen for the kooringal, and it is generally some of them who are selected to use the mungawans in the large ring.

At daylight, or shortly before it, next morning the sound of the bullroarer is heard from the direction of the sacred ground, upon which the women commence to sing *bobbarubwar*, and the men at the ring raise the customary shout. Some of the men now commence to cut forks and bushes with which they put up a bough screen round outside the ring, about two feet from it, on the side opposite the track. This is done by inserting forked sticks in the ground, and laying rails from one to the other; against the rails bushes are laid, one end of the bushes resting on the ground, the other on the rails, and forming a thick screen or fence. The painting of the novices is going on at the same time at any convenient place about the camp. Each tribe paint their own boys. Say, for example, one of the novices belongs to the class Kubbi; a guardian is chosen for him from among the young men of the class Ippai. This man and his sister Ippatha then paint the boy Kubbi. He is first painted red all over with raddle and grease, and then a few white stripes are added about the face and chest, according to the pattern common to his tribe. He is also decorated with bird's feathers in his hair. A Kumbo and his sister Butha paint a Murri boy; a Kubbi and Kubbitha paint an Ippai; and a Murri and his sister Matha paint a Kumbo novice. As soon as all the boys are painted, they are

* Journ. Anthrop. Inst., xxv., 328.

taken and placed sitting on the bank with their feet outside—the group of boys of each tribe sitting on that side of the bank which is nearest their own country, their heads being covered with rugs. The mothers of the boys are now taken and placed lying down on the ground on the other side of the bough screen—each mother being opposite to her son, with her head towards him. The other women and the children are a little farther back. Each woman lies on her side with her head resting on her hand and elbow, and her eyes looking towards the ground. When the women and children are all placed lying down, they are covered over with rugs and bushes, and a few men appointed to watch them.*

During the time that these preparations have been going on at the large ring, the kooringal have also been at work at the *goomee*. They have been painting the whole of their bodies with powdered charcoal or burnt grass mixed with grease, which gives them an intense black colour. The *binnialowee* are likewise preparing for their share of the work by disguising their faces and bodies with strips of bark. The warrengahlee are pulled up out of the goonaba and burnt.

As soon as these arrangements have been completed at the *goomee* and at the camp, the men at the latter form a circle outside of the ring, and each man beats together two nullas, a boomerang and a nulla, a throwing stick and a spear, a nulla and a hielaman, or any other two weapons he may happen to have at hand. The distant sound of the bullroarer, the voice of Dhurramoolun is then heard, and one of the old men sings out: "Here he comes:" others shout out Yooah yananga ("go away") as if addressing Dhurramoolun, and the fathers of the boys pretend to be in great grief. The women and children begin to cry. A number of men from the *goomee* now quickly approach along the track and enter the ring through the opening in its wall, and run round in single file just outside the bank, all the time beating the ground with pieces of bark, *mungawan*, before described. Some of the men have two such pieces of bark—one in each hand—others have only one larger piece which they use in both hands. While these men are running round and beating the ground, but not shouting, the other men who are standing outside are beating

* Journ. Anthrop. Inst., xxv., 329.

their weapons together and yelling hideously to make the women believe they are endeavouring to scare Dhurramoolun away. After the men have gone once round within the ring, beating the ground at every jump, they run away noiselessly along the track to the *goomee* and burn the pieces of bark in the fire there. Two men, one on each side of the circle, are sounding the bullroarers all this time. The guardians then advance and each one catches hold of his novice by the arm above the elbow, and bids him stand up, with his face bent towards the ground and his arms close to his side. The rug is now thrown off, and the boy is marched away by his guardian along the track. During all this time the men around the ring continue to shout and beat their weapons together to prevent the gins hearing the boys going away. These men then enter the circle and run round beating their nullas together, and at the same time obliterating with their feet, any impression which may have been left on the ground by the mungawans, so that the women may not see them when they get up. It frequently happens that small fragments of the bark used in beating the ground break off and remain in the ring. Some of the young men standing around carefully watch for these fragments, and carry them away immediately and put them on the fire. As soon as the *mungawan* men have gone away, some of the men standing round pick up firesticks from the camp fire and throw them into the ring, scattering the embers about.* Perhaps a few large stones are placed in the circle, dilly bags and other things belonging to the women are hung upon trees or scattered about. The men take up one or two of the little children who cannot talk yet, and put a few marks of paint on their faces or bodies. The women are told that the Evil Spirit indulged in these playful freaks when he came for the boys.

As soon as the guardians and novices are out of sight, the rugs and bushes are removed off the women and children, and they are allowed to rise. On looking round, half stupified by supernatural terror and the unexampled din caused by the men, seeing the fire scattered about and their boys gone, they give vent to bitter lamentations for a few minutes. The fathers and relations of the

* The same thing is done at The Burbung of the Wiradthuri Tribes. Journ. Anthrop. Inst., xxv., 308 and 329.

novices, and, perhaps, other men not connected with the ceremonies, now pack up their things and start away after the boys, who have perhaps by this time gone about half-an-hour. The women, and such of the men who remain to assist them, now pack up and proceed to the place decided upon for the erection of the Thurrawonga camp, described in previous pages.

Ceremonies in the Bush.—In the meantime the guardians, *bumbooñ*, have taken the novices, who are now called *wundhamurrin*, away along the track, the boys heads being bowed upon their breasts, and are followed by the men with the bullroarers. On reaching a clear space near the commencement of the *yamunyamun*, all the boys are made to lie flat on the ground, face downwards, with their arms close by their sides, and their feet towards the circle they have just left. If the ground is damp, opossum rugs are spread out for the boys to lie upon. While the boys are lying here, the men who used the mungawans have had time to put on disguises in the shape of strips of bark tied across their bodies like shoulder belts, as well as around their arms and legs, and also across their faces. Being disguised in this grotesque manner they come up quietly and stand two or three yards from the feet of the boys; the guardians are standing by the boys' heads all the time, and clap their hands on their thighs to prevent the boys hearing the men approaching. The novices are then helped to rise, and on getting to their feet they are told to turn round and look at the grotesque figures before them. These men, called *binnialowee*,* now step up quite close to the boys and commence to dance and wave their arms (Irrumburrunga), and shouting *birr-r-r!* The boys now turn their backs upon the binnialowee, who go away to the goomee leaving the boys standing where they were. Two or three men are now seen approaching from a direction about at right angles to the path connecting the circles. Each of these men carries in his left hand a smoking stick, and in his right a boomerang, and are shouting Ah-h-h-ow! and other sounds. On coming within say thirty or forty yards they rush towards the boys and throw, each, a boomerang over their heads. They do not come up to get the boomerangs again, but immediately go away in the direction from which

* Journ. Anthrop. Inst., xxv., 331.

they came. These are the men, *buddenbelar*, who go to fetch the *beegay*, and are the same who subsequently appear in the ring of fire (*Dhurramoolungowee*), details of which will be given later on. The guardians now conduct the boys along the track as far as the goomee, showing them the yammunyamun from the commencement to that point. On reaching the goomee the boys are made to turn their backs to the fire, and their eyes are cast on the ground at their feet. One of the guardians then pretends to see something in the air in the direction of the sun, and says to the novices, "Look up at that bird, you can just distinguish it in the distance." The boys all turn their eyes in the direction indicated endeavouring to see the object, until they are told to look down at some men on the other side of the goomee fire. These men, *millunga*,* are crouching down with their buttocks resting on their heels, and their elbows on their knees; they are pulling down their lower eyelids with their hands, and staring at the boys. The guardians say, "Those are Dhurramoolun's men; they will come and burn you on a fire like that." The sun having momentarily impaired the vision of the boys, when looking towards the sky, they cannot see very clearly, which causes the *millunga* to appear all the more unearthly and demoniacal. Having looked at these men for a minute or two, the boys are taken about a quarter of a mile farther on than the Goonaba, and placed sitting on the ground with their eyes cast down. This delay is made for the purpose of allowing the kooringal to go ahead and get ready for the next performance, which consists of each man cutting a leafy bough, and then all crouching down close together in rank and file fashion; each man holds his bough in such a manner that none of the men are seen, nothing but a heap of bushes being visible. The novices are then brought on with their heads down, and placed standing in a row in front of the bushes, which the men keep shaking as if blown about by a gale, but no other sound is heard. The two head men who accompany the novices and their guardians then stand one on each side of the heap of bushes and one says to the other, "Can you tell me what this is?" The other man will answer, "You are older than I am; you ought to be able to tell us what it is." Perhaps a few ridiculous guesses

* *Loc. cit.*, 331.

are made. The first man then hits the ground with his nulla nulla, and calls out "Dhurraboolbool."* The kooringal then throw down the bushes and spring to their feet shouting and jumping, and swinging their arms up and down in front of the boys.

The boys are then told to hold their heads down, and are taken away to the place appointed for them to camp that night. Here the guardians make a yard of boughs, in which they place the boys. This yard consists of a partial enclosure resembling a semi-circle or a horse-shoe in shape, the width across the open and being about fifty feet, and the depth from there to the back wall about thirty-five feet, but varying in size according to the number of novices and guardians to be accommodated. Fires are lit at the entrance to afford warmth to the occupants when in it. The fence or wall is about four feet high, and is composed of forked sticks driven into the ground, with small saplings reaching from one fork to the other, and the open space between them filled up with boughs so as to form a dense fence which would serve the twofold purpose of preventing the boys from seeing what is done at the men's camp, and also to protect the boys and their guardians from cold winds. About fifty yards from the convex end of this enclosure is the camp of the guardians, and about an equal distance farther still the kooringal make their camp. Such a camp would always be near a water-hole, or close to the bank of a creek or river. About an hour before sundown a small space is cleared on the ground between the camp of the guardians and that of the kooringal. The novices are brought out of their yard, and placed standing in a row on the side of this cleared space. The kooringal now emerge from one side, and go along on their hands and feet one after the other in close succession, imitating the shape and action of grasshoppers as nearly as they can. When all the men have passed by to the other side, they turn and pass along again in front of the boys in the same manner. The two old men then interrogate each other as to what animal is meant, and one of them hits the ground with his nulla nulla and shouts "Grasshopper" (Boonboon) whereupon the men all get to their feet and jump and shout and wave their

* Journ. Anthrop. Inst., xxv., 331.

arms as before described. The novices are then taken back to their own yard, and a few of the guardians left with them. About sundown preparations are made for the evening meal. During the day some game has been caught, which is roasted by the guardians at their own camp, and a fair share of the best parts of the meat, from which all the bones and sinews have been removed, is taken to the boys at the yard. Some of the old men go round at "feeding time" to see that the food given to the novices is prepared in accordance with tribal custom. The object of keeping and feeding the boys in a yard away from the men appears to be to prevent the former hearing any of the discussions which take place among the kooringal and guardians as to the programme of performance for each day, or any other matters which it is thought proper to keep secret from the boys. At bedtime every night the *murrawan* is sounded, and the boys are brought out of this yard and sleep with the guardians at the camp of the latter. The boys are not allowed to speak, and cannot go anywhere without making signs to their guardians, who must go with them.

After supper the guardians bring the boys to the men's camp, and place them lying down with rugs thrown over them. The men then raise a peculiar shout at intervals, which is continued for an hour or two. This shouting, which is called *Bungaroo*,* is kept up for the purpose of inviting and guiding to this camp in the bush, any strange men who may have arrived at the main camp that day. Supposing that a contingent having a few novices to be initiated were a day too late, and, on their arrival, had found that the camp had broken up that morning, and that the old men had taken the novices away into the bush. The women and children of this contingent would go to the new camp and join the other tribes, but some of the men would take the novices and start out after the others. They would not come up to the camp, but would stop for the night somewhere out of sight, perhaps a mile away, at some place where there was water, and on hearing the *bungaroo* shout they would reply to it. Early next morning a few of them would approach the camp, carrying in one hand a smoky stick, and in the other a boomerang, and

* Journ. Anthrop. Inst., xxv., 332-3.

uttering a series of short shouts. The kooringal, guardians and novices at the camp would then stand in a row, and the new comers would rush up near them and then retire and go away to their comrades. In a short time they would return bringing with them their novices, who are brought to the yard and put amongst the novices belonging to the kooringal, who have in the meantime been taken back from the men's camp, and know nothing of the other novices until the latter are placed amongst them. The guardians of the new boys are with them and join the other guardians, and the men who accompany them attach themselves to the kooringal.

After breakfast the men and boys start out hunting for the day. The novices are taken out of the yard, and walk beside their guardians with their eyes cast upon the ground in front of them, and their hands down close by their sides. After they have got out of sight of the camp, they come up to the kooringal, who have started before them and unknown to them. The boys are placed in a row near the edge of a thick patch of scrub, and when all is ready they are told to raise their heads and look. The kooringal come out of the scrub one after the other, imitating the appearance of flying foxes (gahmon). The old men make the usual enquiries of each other as to what animal is intended, and then one of them hits the ground with his nulla nulla and calls out "Gahmon." The boys backs are now turned towards the kooringal for a short time, when they are again told to turn round and look. They now see all the kooringal lying on top of each other in a heap called Boballai,* which I will endeavour to describe. Supposing there are twenty men in the kooringal, first about nine or ten of them would get down on the ground on their knees and elbows, as close together as they could lie; then about half-a-dozen more would lie on top of these, and the remainder on top of the second lot. A groaning noise is kept up by all the men during the time they are in the heap. Most of the positions assumed are very obscene, and some of them disgusting, but judging from the frequency with which this part is enacted, one would think that it must be of more than ordinary importance. It is perhaps intended as a moral lesson to the boys

* Journ. Anthrop. Inst., xxv., 333.

to deter them from unnatural offences and masturbation: or it may be that its obscenity adds to its fascination for the savage mind. After the usual enquiries as to what this is, one of the old men hits the ground and calls out, "Boballai babiabbi." The men then get up and jump and swing their arms. The boys backs are now turned, and accompanied by their guardians they walk away with their eyes on the ground for a short distance, where they are brought to a stand. The guardians then clap their hands and tell the boys to run for about twenty yards,* and stand again. The guardians now give each boy three or four nulla nullas, and they are allowed to raise their heads, and can look in any direction except behind them. Men and boys then go on looking for game, the boys being allowed to join in the sport, but if they chase a wallaby or any other animal, and it runs into the rear, they cannot follow it, even if wounded, but must let it escape. About mid-day, perhaps, they come to a water-hole where they rest and have dinner, cooking the game they have caught during the morning, after which they go in quest of game on their way back to their camp of the previous night. At some suitable place, the boys will be placed standing in a row with their heads down, and in a little while will be ordered to look up, when they see the kooringal jumping past in single file, imitating kangaroos.† Each man has a tail made of grass and reeds, or it may be of small bushes, tied up in a roll and stuck under the hinder part of his girdle, so as to represent the tail of the kangaroo.‡ They also have their hair tied into two bunches, to represent the kangaroo's ears. When the kooringal have all jumped past once, or it may be several times, the two head men ask each other what this performance means, and then one of them hits the ground as usual and calls out, "Bundar" (kangaroo). The boys are ordered to turn their backs with their heads down for a few minutes, and when they look again they see the kooringal lying on top of each other in a heap, boballai babiabbi.

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* This ceremony of giving the boys a short run always precedes their liberation for the purpose of joining in the work of hunting.

† Journ. Anthrop. Inst., xxiv., 423.

‡ Lieut.-Col. Collins, in his "Account of the English Colony in New South Wales," published in 1798, vol. i., p. 571, plate iii, describes a similar performance which took place at the Bora witnessed by him in 1795, at the head of Farm Cove, Sydney.

Having given their attention to this for the necessary time, the old men interrogate each other and hit the ground, calling out the name of the performance, as described previously. The men then get up and jump and swing their arms as usual. The boys are again ordered to look down and are marched away. After going a short distance they are halted, then ordered to run about twenty yards, when they are stopped again, and given three or four nulla nullas each. They are now at liberty to join in the hunting occupations of the guardians, but must not look behind them. Chasing padamelons, looking for snakes, etc., climbing trees for wild bees' nests, are now indulged in all the way back to the camp, which is reached a short time before sunset. On getting within sight of the camp the boys are ordered to hold their heads down, looking at the ground straight in front of their feet only, and are conducted in this way into the yard, where they are left in the care of a few of their guardians, while the others go to the camp and prepare their evening repast, which is brought by-and-bye to the yard. Even in the yard they must not look towards the camp of the men. After the kooringal and guardians have also had their supper and a rest, at their own camp, two or three small fires are lit, near the cleared space previously mentioned, for the purpose of giving light for the performance about to take place. The guardians now bring the novices from the yard, and place them standing in a row close by this space. The kooringal then appear with boomerangs, nullas, etc., stuck in their belts and in strings tied round their legs and round their shoulders for the purpose of holding these weapons. Some of them pretend to be lame, others are each carrying a man on their back; they catch hold of his legs and his head hangs down their back. All the men are following in a line stamping their feet, and each man has hold of the one in front of him. The rear consists of a man dressed to represent a woman, who carries a yam-stick and has a blackfellow alongside. The other men pretend to want to take the woman from him, and indulge in obscene gestures. Having asked the customary questions of each other, one of the old men hits the ground and shouts: "Goolangarra." The novices now turn their backs, and on looking round again the men are all in a heap, *boballai*, and the usual formula is gone through by the old men. The boys

are now taken away to their yard, where they remain with a few of their guardians till bed-time. The procedure for to-morrow is now discussed by the head men, the kooringal and the guardians. When this matter has been disposed of, the boys are brought back, and put in the place appointed for them to sleep, their guardians being with them, and all hands retire to rest.

The next morning at day-light the boys are taken back to their yard, where food is subsequently taken to them. When all have breakfasted, a start is made out into the bush for the purpose of hunting. It may be that it has been decided to shift their camp to a fresh place, and in that case their things would be carried with them. The boys carry nothing—their things being carried by their guardians. The boys walk with their heads down and their arms close by their sides, and when out of sight of the camp are liberated by giving them a short run and handing them nulla nullas, as before described, and hunting or fishing is carried on all day as usual. During either the fore or afternoon, the pantomimic performance of the Curlew (Graybai) is gone through by ranging the boys in a row with their heads down, their nulla nullas having been taken from them. The kooringal then run along past in front of them, imitating the action and whistling of the curlew. The old men hit the ground and the men go in Boballai in the usual way. On getting into camp that evening an hour or so before sundown, the play is Native Bees (Oongomurra). Around the butt of a tree a number of bushes are placed with their ends leaning against it. The kooringal are standing round the base of the tree, hidden by the bushes and are humming like bees. The boys are brought up with their heads down, and are ranged in a row and told to look up. When an old man hits the ground with his nulla nulla, the men come out on all fours one after the other humming and imitating the walk of bees. The boys backs being now turned, the men go into Boballai as usual. If it is a fresh camping ground, a yard is made for the boys and the camp arranged as previously described. After supper a couple of small fires are lighted beside a cleared space, between the camp of the guardians and that of the kooringal, and the boys are brought out of their yard and placed standing on one side. The men now pass along in a crouching attitude, jumping and shaking their arms; the

front man and the last have each a piece of string one end of which is held in each hand, and the middle of the string is held between the teeth. This string is drawn from side to side, the men making a low noise with their mouth, which noise is repeated by all the other men who have no string. As soon as all the actors have passed by into the darkness on the other side, they return repeating the performance. This is done several times and when the old men think it has been continued long enough, they bring it to an end by hitting the ground and naming it Warringun.* The usual course of turning away the boys' heads for the preparation of Boballai, concludes this act, and the boys are taken back to their yard till bed-time, and are then again brought to the men's camp for the night.

Next morning the usual routine is gone through, and a start made into the bush in search of food. During the forenoon the boys are brought to a stand at one end of a heap of earth or sand, into which a number of pieces of stout grass or reeds about four or five inches in length have been inserted closely together like the quills on a porcupine. The old men make the usual interrogations as to what it is, when one of them says: "It must be a porcupine" (Wiroyla) and inserts the end of his nulla nulla under one side of the heap as if to turn it over. A man who was concealed under this covering now rolls over on his back with his legs and arms gathered up in the same way as a porcupine does when it is turned over. The men and boys then resume their hunting. On reaching the camp a short time before nightfall the pantomime of Wonga Wonga Pigeon (Googan Googan) is performed. The kooringal paint white patches on their bodies in the position on which they appear on the bird, and then walk past imitating the note of this kind of pigeon. The usual formalities ensue, and the performance ends by the men going into Boballai. That night after supper the boys are brought to the clear space at the camp, and a fire lighted. One man beats two boomerangs together. The others then dance around with sticks in their mouths; these sticks are merely dry pieces of wood, and are from eighteen inches to two feet six inches long, about the

* Journ. Anthrop. Inst., xxv., 334.

thickness of a whip-handle, picked up around the camp. After dancing a few minutes the men throw the sticks out of their mouths into the fire, and go and get other similar sticks. This is repeated for some time, after which all the men dance round the fire for a little while without anything in their mouths. The fire having now burnt down to cinders, the men jump upon it with their naked feet and scatter the embers in all directions and put it out. This dance is called Boodell Boodellyinga.

Next morning a start is made as usual, and when a short distance from the camp, the Kangaroo-Rat (Nooloobooonya) is represented. The boys are placed as usual and the kooringal are seen gathering bunches of grass, which they carry in their arms and build a nest like the kangaroo-rat, only much larger. When the nest is completed, the men, one after another, go and put their heads in it, and then hop past the boys, imitating the shape and action of the animal. The men then go into Boballai, after which a fresh start is made. The boys are made to run several yards, and nulla nullas given them as before described, and all hands go on hunting. It may be that the novices are not kept together. One lot of guardians and their novices may go in one direction, and another lot may go into a different hunting ground, and these detachments may not meet again until their return to the camp perhaps an hour or so before sundown. One lot on approaching the other would whistle. When they all get together near the camp, the game of Locusts (Ngaddalla) is performed.* The boys stand with their heads down while the kooringal climb trees, and catch hold of the branches imitating the position and noise of locusts. The boys are then told to look, and in a short time the men come down from the trees and crawl along the ground past the boys, and conclude the performance by going into Boballai. The novices having been taken to their yard, and all hands having had supper, a fire or fires are lit alongside of the cleared space at the camp, and the boys brought to see the performance. The kooringal are painted in white stripes extending from the feet to the neck, with a central line from the forehead down the nose, chin and body, terminating at the end of the penis. White circles are also drawn around the

* Journ. Anthrop. Inst., xxv., 333.

eyes. They dance along past the fire in pairs, having hold of each others hands, the outside hand of each man resting on his hip, uttering monotonous exclamations all the time. Some of the conjurers then perform tricks of pulling things out of their bodies, and running after the other men, the whole concluding with the kooringal going into the heap, Boballai. After this, men and boys retire to rest for the night.

The following morning, after getting away from the camp, the pantomime is Wood-Ducks. The kooringal come out from one side and run with a waddling gait past the boys, quacking and falling over each other as they go. The backs of the boys are turned for a few minutes, and the men are seen in a heap, Boballai. The boys are marched a short distance away and liberated in the usual manner, and join the men in hunting. Some time during the day the kooringal go away to a place where the soil is soft, or to a sand ridge, and make a hole in the ground about two feet deep. A man with his head hideously disguised, and an opossum rug wrapped around him, is placed in the hole. The others then withdraw, and the novices are brought within twenty or thirty yards, when their attention is drawn to the strange figure, and are told that it is a man rising up out of the ground, perhaps some of their ancestors. They are then marched away, and resume their hunting.

The following appears to be a variation of the above: Two men are disguised with white stripes of brigalow bark tied across their bodies and limbs and a piece of bark strapped to the penis to give it the appearance of almost touching the ground. These men have their feet in holes about a foot deep, dug in the ground to give them the appearance of coming up out of it, and each has an opossum rug loosely thrown round him. The boys are brought within a short distance, but not too near, and are shown these figures, who are waving their arms about, and who are called Dhandarroogan (or Dhungully).

Having returned to the camp and the evening meal over, the novices are brought to the cleared space. Some of the wizards will take a stick out of the fire and will apparently bite a piece of the burning coal off one end of it. They run about clapping their hands on their hips and going through obscene gestures. During this time they will apparently bring different substances,

such as white stones, pieces of string, etc., out of their bodies. When this kind of amusement has been indulged in for some time, such of the men as are good singers commence chanting Baiamai's song.*

After breakfast next morning, two of the wizards go away into the bush adjacent and smear their faces, arms and bodies with human blood, taken from the arms of some of the men, and come out to where a large fire has been lit, accompanied by about half-a-dozen or more young men beating the ground with pieces of bark and shouting "Barri-barri" repeatedly as they walk. The two wizards referred to then chase the kooringal and guardians, but not the novices, round the fire several times—the bullroarer being sounded out of sight in the bush close by. The men with the bark now sit down a short distance off, and continue beating the ground; and one of the wizards stands beside them having in his hand a coolamin, out of which he drinks human blood. At the finish, all hands, except the boys, dance and shout and close in round the fire. After this the boys heads are turned away, and the kooringal go into Boballai.

When the head men consider that the novices (Wudhamurrin) have gone through a sufficient course of instruction and discipline in the bush, a number of strange men who have arrived at the women's camp since the boys were taken away are despatched to liberate them. These men are called the *Beegay*, and a messenger is sent out to the kooringal to let them know they are coming. The *Beegay* then start away from the main camp and proceed to a water-hole in the bush, which has been decided upon by the head men as the place where the kooringal and guardians are to wash the black paint off their bodies. At this water-hole the *Beegay* leave their personal effects in charge of a few of their own men, and go into the bush in search of the kooringal and novices. They know where to go, because the locality has previously been determined upon.

On the day which has been arranged to meet the *Beegay*, the kooringal, bumbooñ and boys start out as usual and carry all their things with them, as if shifting camp. When they reach the appointed place, which is in a piece of open country, their

* Journ. Anthrop. Inst., xxv., 334.

swags are laid down and a fire lit, at which the old men remain. The boys are then taken away on the pretence of accompanying the men hunting, and one or more of the kooringal go ahead unseen by the boys, in order to see where the *Beegay* are. On sighting the latter and exchanging signals that all is ready, the kooringal scouts return and inform their comrades. The boys (*Wundhamurrin*) are placed sitting on the ground in a row with their heads down, and their backs towards the direction from which the *Beegay* are to approach. The kooringal are standing in a row behind the boys. The guardians then tell them to listen, that Dhurramoolun is coming to burn them. The Beegay, painted with white stripes, are by this time quite near, carrying in the right hand a boomerang, and in the left a smoking stick. One of them raises a low continuous whistle, on hearing which the guardians tell the boys to get up and run back to the place where they left their swags, looking only at the ground in front of them. The boys then run as hard as they can in company with the guardians for about 200 yards, when the guardians command them to lie face downwards on the ground with their hands by their sides for a minute or two. They are then ordered to get up and run again. These spells of running and resting are continued until the temporary camp is reached, when the boys fall face downwards on rugs ready spread for them. The whistling of the Beegay has been heard close behind them all the way. The reason for making the boys lie down at intervals is to prevent their getting too excited and frightened, and becoming unmanageable, and also to enable the Beegay to keep pace with them. As soon as the boys lie down the old men, who remained there, say, "We will now give you a drink before you are burnt." After this some of the men will clap their hands whilst others take fire-sticks and touch the boys on the legs to make them believe that Dhurramoolun is commencing to burn them. The kooringal say, "Don't be in a hurry to burn the boys! go away!" The fathers of the novices are there, and pretend to be in great grief, lamenting and hitting themselves on the head; the boys are in a great state of fear, but do not attempt to move.

During this time the Beegay are renewing their fire-sticks, in order that they may make a good smoke. Then the boys are helped to their feet and are placed standing in a row, the fathers

of each boy saying to the guardians, "Hold my boy; he is going to be taken away and burnt." The kooringal are standing in a semi-circle behind the boys. The boys faces are now turned towards the Beegay, who are swaying their smoky sticks, and the guardians say, "There they are; they have a big fire over there," pointing in a certain direction. The Beegay then run up towards the boys dancing and shouting and swaying their smoky sticks and boomerangs. The guardians then turn the boys backs towards the Beegay, who come up and pass along the row of boys, each man catching the back hair of each boy in succession, and pulling his head up straight. The class distinctions are so interwoven with the ceremonial that, even in this matter, they are not lost sight of. A Dilbi* Beegay would shake the hair of a Kubbi or Murri boy heartily, because he belongs to the same class, but would only lightly shake the back hair of a Kumbo or Ippai; the Kupathin men would show a similar preference for the boys belonging to their own class. This pulling of the back hair is done for the purpose of freeing the novices from the stooping position in which they have had to walk during the time they have been out with the kooringal. After this, the Beegay retire several yards, shouting as before, the boys remaining with their backs towards them.

The Beegay then form into a semi-circle, and join the semi-circle formed by the kooringal, making a complete ring of men around the boys. Two men now step out into the open space within the circle and commence swinging bullroarers, and the kooringal beat their weapons together and call out, "Don't burn the boys yet." When the men with the bullroarers get giddy, they are replaced by others, who keep the instruments sounding continually. Amidst this tumultuous clamour of human voices, clashing of weapons and roar of *murrawans*, the boys faces are turned round and they are told to look. The guardians tell them that these instruments represent the voice of Dhurramoolun, and that all the similar sounds which they have yet heard have been made in this way. The men now caution the boys not to reveal what they have seen to the women, or the uninitiated, or

* "Kamilaroi Class System of the Australian Aborigines," Proc. Roy. Geog. Soc. Aust. (Q.) x., 19.

they will be punished with death. The Dilbi men caution the Dilbi boys, and the Kupathin men caution the Kupathin boys, and while doing so hold up tomahawks or spears in a threatening attitude. The guardians now put the full dress of a man on each of the novices, consisting of a belt with four barrunggals, a broad and a narrow head-band. They are now called *tuggabillas*,* and are freed from any further restraint. Some of the wizards perform feats of juggling, and this part of the ceremony is over. Up to this point the guardians have been carrying the rugs and other things belonging to the boys, but now they will have to carry them themselves. The Beegay now start for the water-hole where they left their swags, and the kooringal, bumbooñ and tuggabillas follow them at a distance. A few men who had been left here have made a ring (*Buddhamoor*) about fifteen or twenty yards in circumference, its boundary being formed by a continuous wood fire. In the middle of this ring of fire are two men swinging a big nulla nulla in each hand, dancing about and imitating different animals. These are the two men (*buddenbelar*), who threw the boomerangs at the boys the first morning on which they were taken away. The Beegay are the first to reach this place, and they lie down on the opposite side of the ring to that in which they have just come. Presently the kooringal, guardians and neophytes arrive at the other side of the ring and commence stamping their feet, swaying their hands, in which they carry weapons, up and down, and uttering low monotonous shouts. Then the Beegay, who are, as before stated, lying down on the opposite side of the ring of fire, rise to their feet, and act in a similar manner. During this time the two men have been in the ring, but now they retire, and the Beegay enter it, dancing round and shouting. Some of their wizards go through various feats of pulling things out of various parts of their bodies, and chasing the other men, who clap their hands on their hips and shout. These ceremonies being concluded, the Beegay drive the kooringal and the guardians into the water-hole close by, where they wash the black paint off themselves, the Beegay and the novices sitting on the bank watching them. After this the kooringal and their contingent camp at

* Journ. Anthrop. Inst., xxv., 336.

the water-hole for the night, but the Beegay go away back to the camp of the women, perhaps a mile or two distant.

A few of the oldest women then muster all the women and girls in the camp, not including the children, and drive them into a water-hole or creek close by, and make them swim about and wash themselves. When they come out of the water, they go and select a suitable level place near the camp, which they clear of grass and rubbish, ready for enclosing by the thurrawonga, or bough yard, the next day. The distance from the camp to the thurrawonga may vary from about 200 yards to 500 yards, according to the suitability of the ground, and other considerations.

When the kooringal and their companions have had supper, some of them take the neophytes, and proceed towards the camp of the women.* On coming within hearing, they break up into sections according to their respective tribes, each section of novices approaching that side of the main camp occupied by the tribe to which they belong. Each lot of boys is accompanied by one or more of the men, who climb up into a tree, just outside the camp, and shout, and the women know the men's voices. Then each boy shouts out in succession, and is answered by his mother. During this time one of the boys is swinging a murrawan at the butt of a tree. The women then pick up fire-sticks and hold them in their hands, or wave them in the air, or perhaps throw them up. The boys of each section act in the same way adjacent to the quarters of their mothers. The men and boys now return to their comrades at the camp out in the bush. The ceremony of giving the boys a new name is now proceeded with. This is done by the old men and the fathers of the novices. The Ippais give names to the Murri boys, the Kubbis name the Kumbos, the Murris name the Ippais, and the Kumbos name the Kubbi boys. While the boys were away at the women's camp, two men had climbed each a tree, and as each boy was named by the old men, one of these would shake the branches and shout out from his tree, imitating the noise of some animal. Sometimes they micturate in imitation of opossums and squirrels. When all the boys are named, the men who have been

* Journ. Anthrop. Inst., xxv., 336.

up in the trees come down, and raise a lamentation that the bora ceremonies are over. Such of the young men present who had been initiated at previous boras now ask the old men to release them from certain prohibitions which had been imposed upon them as to food. Food restrictions are now imposed upon the neophytes.* After this all hands go to sleep at the camp fires for the night.

Return of the Boys.—Early next morning the men and boys have their hair cut, and the men are shaved, face and pubes, after which the boys are painted red all over, with white stripes drawn diagonally across their bodies from the direction of each shoulder, and also on the arms and legs. Belts, kilts, etc., are also worn. The men are painted with red stripes from the waist down to the feet, and from the elbows to the hands. Feathers of the eagle-hawk or swan are put in the hair. A messenger is sent on ahead to the gin's camp to tell them that the men and boys will shortly arrive.

The women, assisted by the Beegay, have in the early morning cut saplings and bushes, and made a yard around the cleared space before referred to. This yard is similar in shape to those made in the bush, but larger, because intended to accommodate a greater number of men. Its convex end is in the direction from which the boys are expected to approach. In this yard the mothers of the guardians and kooringal have placed their yam-sticks around, about two or three feet from the fence, each stick having some article belonging to the owner attached to it, in order that the men may recognise them. Around the outside of the convex end of this yard logs of wood are laid. The Beegay now cause the women to lie down round the outside of the yard, the mothers of the boys occupying the space nearest to the fence with their feet touching the logs just mentioned. The men and women who have charge of the thurrawonga are called *moomalla*. The women are then covered over with rugs and bushes. On a signal being given that all is ready, the neophytes and their guardians now approach in single file, and the latter conduct each boy to his mother on the outside of the enclosure and place him sitting down on the log which her feet are

* Forbidden food is called *wunnal*.

touching. The guardians and kooringal then enter the yard, and each man sits down facing his mother's yam-stick. Each novice then shakes the log to let his mother know he is there, but does not speak, and then runs away, not looking behind him, to a camp two or three hundred yards away, provided for the novices and their guardians. During this time the bull-roarer is heard in some place adjacent, but out of sight.

As soon as the boys run away, the women are allowed to get up. They then pull down the bushes forming the yard and find the men sitting there—the latter now get up and dance and make a buzzing or humming noise on the cleared space inside the thurrawonga—the women standing around. The women then take the men to some convenient place close by, where they place them in four groups, the men of each class being together, and light fires to the windward of them. Green bushes are placed on the fires to make a thick smoke. The Dilbi women smoke the Dilbi men, and the Kupathin women smoke the Kupathin men. After this the men disperse to their usual quarters. In the meantime all the neophytes have gone into their own camp accompanied by some of the men. That night the novices, accompanied by some of the men go round the women's camp, out of sight, and walking quietly so that their movements may not be heard, sounding bullroarers.

Next day the boys, carrying a smoky stick and bushes, are brought up to the women's camp, a man sounding a bullroarer behind them in some secluded spot. Several men walk behind the boys, throwing pieces of bark at them, sometimes hitting them. On reaching the women's camp the boys are placed sitting on a log in groups according to their classes. The women then light fires on which they burn green bushes on the windward side of the boys, so as to envelope them in a cloud of smoke. The Dilbi women smoke the Dilbi boys and the Kupathin women the Kupathin boys. The mothers hold the boys in the smoke.

After this ceremony, the various tribes who have attended as visitors make preparations for returning to their several districts, and in the course of a few days all have gone away. The novices of each tribe are kept under the control of their guardians for some time, and have to conform to certain rules laid down by the old men.

Art. XII.—*Probable Miocene Age of a Conglomerate at Shelford.*

(With Plate VII.).

By J. Dennant, F.G.S., and J. F. Mulder.

[Read 13th August, 1896.]

For some years boulders of gritty ironstone containing casts of fossils have been reported by various observers as occurring on a hill adjoining the Shelford Cemetery, but the material appeared so unpromising that geologists have hitherto abstained from undertaking a detailed examination of it. The position of the boulders *on* the basalt precludes their being classed as a portion of the eocene, which underlies this rock not only in sections close at hand but also in those of neighbouring areas, and the opinion has indeed been hazarded that they might be pliocene, mainly perhaps, because that age had been previously assigned to the lava flows around.

We first saw blocks of the conglomerate placed amongst basaltic boulders along a portion of the fence bordering an unformed road up the western slope of the Leigh River Gorge. It was too late when we arrived in Shelford to seek for them *in situ* that day, and we were, in fact, told that our search would be fruitless, as the oldest inhabitant could give no information as to where the stones came from. This mystery, however, was, as we anticipated, easily cleared up the next morning, since they were found in abundance just below the surface in the adjoining paddock, from which, of course, the loose stones had been picked up, and then piled against the fence. This paddock lies south of the road and adjoins the cemetery, in which also embedded blocks of the conglomerate are common. The same material also crops out in a shallow gully, just over the fence on the opposite or southern side of the paddock, but ceases on the rising ground beyond. To the north of the road, we could find no trace of the fossiliferous strata, nor indeed in any other part of the gorge, though we searched at about the same level in several places. We should certainly expect similar boulders to occur elsewhere on the river bank, and possibly a more thorough search may

yet reveal them. Going up the road by the side of the fence, the conglomerate commences near the cemetery gate and disappears about 140 yards from the top of the hill. Further details concerning the elevation and horizontal measurements of the outcrop will be more conveniently given later on.

The matrix of the boulders consists of ironstone with numerous small, rounded, quartz pebbles irregularly scattered throughout the mass. There is no creek or cutting where they occur, and we noticed them merely as slight protrusions here and there in the surface soil, much in the same way as blocks of lava appear on the plains and hill slopes of ordinary basaltic country. They are crowded with fossils, but all as casts only, the lime of the shell being entirely replaced by iron oxide. When the cast is an internal one, the fossil is not, as a rule, easily identified, but with an external cast, or rather mould, where, as is often the case, the ornament of the formerly enclosed shell is clearly delineated, there is less difficulty; and besides, the opportunity is afforded of reproducing its outline and exterior markings in some plastic material. Our own attempts at this were only moderately successful, and we were very glad to avail ourselves of the generous offer made by Mr. G. Sweet, F.G.S., to prepare models from the fossil casts obtained. Our heartiest thanks are due to this gentleman, as he has enabled us to determine with certainty many of the forms represented.

One of the commonest casts is that of *Pecten anti-australis*, the exterior ornament of which is often beautifully preserved. Amongst other easily identifiable casts may be mentioned, *Zenatiopsis angustata*, of large size, *Pelicaria coronata*, *Chione propinqua* (mioc. var.), *Myodora corrugata*, *Leda woodsii*. Models of all of these have been prepared, as well as of the majority of the other species catalogued.

In the following table of fossils from the conglomerate, the asterisk before the name signifies that the species is represented by many examples. The dagger indicates that fossils from this bed were also so identified by Professor Tate from casts sent to him some years ago by Mr. Sweet. Having been allowed to examine the same collection, we are able with the additional material on hand and by the aid of the models prepared to omit the query then placed against some of the names.

TABLE OF FOSSILS WITH THEIR DISTRIBUTION.

Name of Fossil.	Miocene.			Other Occurrences and Remarks.
	Muddy Creek.	Gippsland.	South Australia.	
Cancellaria wannonensis, *Tate*	x	x		
*†Pelicaria coronata, *Tate*	x	x		Well sinking, Murray Desert.
Diastoma ? sp.				
Calyptraea corrugata, *Tate*	x		x	
Astele sp. (†Trochus sp.)	?			aff. A. granosa, *Tate*, m.s.
Emarginula sp.				aff. E. candida, *Reeve*.
Cylichna sp.				
*Ostrea arenicola ? *Tate* (†O. sp.)		x	x	
*†Pecten anti-australis, *Tate*	x	x	x	
Mytilus sp.				New sp. ?.
†Modiola sp.				
Pectunculus cainozoicus, *T. Woods*	x	x		Eoc. various localities.
*Nucula tenisoni, *Pritchard*	x	x		do.
*Leda woodsii, *Tate*	x			do.
Leda vagans, *Tate*		x		do.
Cardita solida ? *Tate*	x			Cheltenham.
*†Chione propinqua, *T. Woods*	x	x		Muddy Creek var.; abundant there in upper beds, scarce in lower.

TABLE OF FOSSILS—*(Continued).*

Name of Fossil.	Miocene.			Other Occurrences and Remarks.
	Muddy Creek.	Gippsland.	South Australia.	
Chione subroborata, *Tate*	x	x		
*Dosinia johnstoni, *Tate*	x			Eoc. Table Cape, etc.
Solecurtus dennanti, *Tate*				Eoc. various localities.
Mactra sp.				New sp. ?.
Mactra ? sp.				
*†Zenatiopsis angustata, *Tate*	x	x	x	Cheltenham. Eoc. Table Cape, R. Murray. A characteristic shell of the upper beds Muddy Creek; not present in the lower.
*Corbula ephamilla, *Tate*	x	x	x	Eoc. various localities.
Lucina affinis ? *Tate*	?	?	x	
Tellina ? sp.				
*Myodora corrugata, *Tate*	x	x	x	
†Waldheimia ? sp.				
†Cellepora sp				
†Retepora sp.				

That the above list of fossils is a short one, as compared with those usually supplied for the tertiary deposits of the province must be attributed to the difficult nature of the material in which they are embedded rather than to the scarcity of the forms present. Many of these, from their small size, or indefiniteness of the preserved outlines are quite unrecognisable, while for others models have to be prepared. Even with the aid of these, the species, and occasionally the genus also, may still remain doubtful, especially in the case of bivalves, where the hinge characters can rarely be made out.

In discussing the horizon of the strata we propose to take account only of those fossils the distribution of which is definitely given in the table. Eighteen species are thus available, of which eight are confined to the miocene division of the tertiaries at Muddy Creek, Jemmy's Point, Aldinga Bay, or the Murray River; while many of the remainder though present also in the eocene, are in reality specially characteristic of the miocene. With only eighteen species as a basis for calculation, the percentage of living forms represented would of course be an unreliable test of geological age. As a fact, no undoubted recent species appears in the list, though it may be mentioned, that one of them, viz., *Nucula tenisoni*, formerly known as *N. tumida*, T. Woods, is regarded by Mr. Pritchard as both recent and fossil.* Under these circumstances reliance is placed upon the correlation of the fauna with that in other deposits, which, if correctly given in the above columns, indicates a miocene horizon for the Shelford Conglomerate. On stratigraphical as well as on palæontological grounds, the deposit must be separated from the neighbourhing eocene, while to be even late pliocene, it should show a large proportion of recent shells. Its relation to the accompanying igneous rock has next to be considered, and with reference to this our hesitation in at once classing the strata as miocene, when first met with, was chiefly due, since previous conclusions concerning the age of the basalt are thereby called in question.

The position of the outcrop, as well as our theory of the sequence of the rocks is illustrated in the appended sketch,

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* Roy. Soc. Vic., vol. viii., p. 128.

which is approximately to scale. The elevations are from aneroid observations of our own, and the distances of the stations on the hillside have been measured for us by Mr. Swan.

At the particular portion of the river bank where the conglomerate appears, the eocene beds are not visible, but we consider ourselves justified, from evidence obtained at other portions of the gorge, in assuming their existence here, and at no great depth beneath the basalt; at the base of the section they may indeed be somewhat more deeply seated than the drawing indicates, while the outline of their surface farther in the hill is of course uncertain. North of Shelford, outcrops of the strata also occur, but generally reaching a higher level on the banks, and an uneven surface is thus indicated, which points to erosion before the outflow of the lava took place. In the section figured, the basalt appears first at a height of fifty feet above the water's edge, and our conclusion that it is there *in situ* is confirmed by the fact that the eocene strata of the Red Bluff, a mile and a half down the stream, are covered by lava at about the same elevation. Going still farther up the hill, a moderately deep quarry in solid basalt is 110 feet above the same datum line. Beyond this quarry and at a height of 145 feet above the river level, the first block of the conglomerate *in situ* was observed. A few scattered pieces were found on the surface a little lower down, but they have probably come from above. The fossiliferous boulders can be traced up the hill from this point for a distance of about 150 yards, and for thirty-five feet in vertical elevation, or to a height above datum line of 180 feet, when they cease, and the only stones cropping out higher up belong to the prevailing lava flow. By a farther rise of forty feet in a distance of 137 yards, the summit of the western bank of the river gorge is reached, its total height being thus 220 feet. The distance from the water's edge to the level country bounding the gorge is 766 yards, so that the slope, like that on basaltic banks generally, is a gentle one. On the east of the river there is an extensive flat before the corresponding rise commences, but the aneroid recorded almost exactly the same elevation for the top of the bank on that side, and we may therefore conclude that the lava once spread as a level sheet right across the present gorge, which has been since excavated to the depth mentioned.

The measurements just quoted show that the boulder bed is separated from the underlying eocene clays and limestones by not less than ninety-five feet of basalt, that is, from the outcrop of the latter at the base of the section to the first appearance of the conglomerate up the hill; moreover, from the fact that the quarry alluded to is situated at a lower level than the boulders, we may fairly infer the continuance of the igneous rock beneath them for their whole extent. If, in excavating the quarry, the fossiliferous boulders had been revealed, a different conclusion would be possible, as in that case they might simply represent a miocene inlier, surrounded and partially covered by a subsequent flow of lava. Such an explanation is, however, inadmissible, as they are not only absent there, but, as we have before said, do not show in any cutting or natural section along the river bank: and we are therefore driven to seek some other interpretation of the facts.

At Muddy Creek, as is well known, miocene strata are covered by a lava flow, usually regarded as of pliocene age, but that this was contemporaneous with the basalt overlying the eocene of the Leigh River, is, independently of the fossil evidence now presented, open to doubt. It is generally admitted that in the eocene, pliocene, and perhaps also the pleistocene periods, outpourings of lava took place over various portions of Southern Australia, but with one exception, the authors of recent memoirs on our tertiaries refrain from classing any of the basalts as miocene. If, however, the fossiliferous boulders of the Shelford section are miocene, the lava upon which they rest, may, provisionally at least, be referred to the same period—certainly it cannot be younger. Our theory, in fact, is that the Shelford basalt is a miocene flow covering the wide spread eocene strata of the region. Then, after the channel of the river had been partially excavated, the miocene conglomerate was deposited either in a slight depression hollowed out of the basalt, or upon its gently sloping surface. It is not unlikely that this portion of the Leigh River represents an old estuary connected with the former sea-channel, which, as pointed out by Mr. Murray, existed in tertiary times between the Cape Otway Ranges and the mainland to the north.* As the deposition of the boulders commences

* Geology and Physical Geography of Victoria, p. 122.

at about forty feet from the top of the bank, and continues for thirty-five feet lower down the hill, it follows that the estuary or inlet was invaded by the miocene sea until about one-third of the present depth of the gorge had been excavated. The conglomerate for the whole of the thirty-five feet of vertical extent in which it is traceable is intermingled with blocks of lava, and is therefore probably nothing more than a collection of scattered boulders resting on the basalt and not reaching far below the surface. The iron oxide in them is of course derived from the basalt, while the quartz pebbles plentifully intermixed with it were doubtless washed down from silurian country higher up the river.

The southern portion of the Leigh River has not been geologically surveyed, but in a report upon its upper course by Messrs. Etheridge and Murray, written in 1868, but not published till 1874,* it is incidentally remarked that the basalt around Shelford was derived from Mount Mercer, an extinct crater seventeen miles to the north. In describing the results of their detailed work, which was confined to the more northern area mentioned, the further statement is made that certain drifts and gravels, classed by them as pliocene underlie the same basalt. Such a position for pliocene strata is manifestly opposed to our theory that the igneous rock is not younger than miocene. It is possible that the basalt they refer to may belong to a different flow, more than one being mentioned in their report, but as we did not visit the sections in the surveyed area, we can offer no opinion upon the point. We may remark, however, that the geological ages of the various drifts and gravels of Victoria are not precisely known, the descriptive terms applied to them by the geological survey being admittedly, to some extent provisional. The best of all evidence is, of course, that afforded by marine fossils, but from the nature of the case, it is seldom available. Moreover, the revised nomenclature of the tertiaries adopted by the majority of recent writers has to be considered—if, as they contend, the former miocene of the survey has to be read as eocene, possibly also the term pliocene may, in some cases at least, need to be interpreted as miocene.

* Progress Report, No. II., p. 101, *et seq.*

The late Mr. Wilkinson, when a member of the Victorian Survey Staff, traced an old gravel from Steiglitz down the Moorabool, and in accordance with the classification of the tertiaries then current called it miocene, but which, as Mr. Pritchard has pointed out, should be altered to eocene or even pre-eocene.* In a similar manner, some of the so-called pliocene drifts and gravels may, when re-examined in the light of knowledge now possessed, prove to be of miocene age. In regard to those of the Leigh River Valley, reliable data for determining their geological horizon within narrow limits are, as we have seen, furnished by the marine beds with which they are associated. Further discussion of this subject would, however, be out of place in the present paper, and it is therefore postponed for some future occasion.

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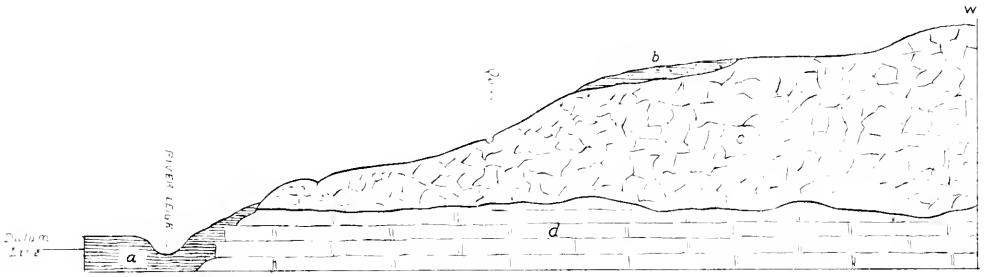
* Aust. Ass. Adv. Sci., Brisbane Meeting.

Sketch Section of West Bank of Leigh River at Shelford

Approximate Scale :-

Horizontal, 200 yards to 1 inch: Vertical, 200 feet to 1 inch.



a Alluvium, b Fossil conglomerate c. Basalt, d, Eocene

Proc R S Victoria 1896 Plate I

Art. XIII.—*On the Occurrence of Graptolites in North-Eastern Victoria.*

By T. S. Hall, M.A.,

Demonstrator and Assistant Lecturer in Biology in the University of Melbourne.

[Read 3rd September, 1896.]

Some two years ago Mr. W. H. Ferguson gave me a small collection of graptolites, some of which he had obtained at Wombat Creek near Mount Wills, and the rest near Tungamah. The presence of *Dicranograptidæ* showed at a glance that the rocks belonged to the upper portion of the Ordovician series, but the smallness of the collection and the imperfect nature of many of the specimens caused me to lay them aside in the hope that a larger and better series would be forthcoming. Mr. Ferguson has not, however, had an opportunity of re-visiting the localities, but during an examination of the country in the north-east of the county of Benambra he was fortunate enough to find a fresh fossiliferous locality on the banks of Walwal Creek. The specimens which he found on this last occasion were placed at my disposal, through the courtesy of Mr. J. Travis, the Acting-Secretary for Mines, with the request that I would identify the specimens. I wrote a short report which was handed in to the Department, but its publication is delayed for the present.

Wombat Creek.

The locality from which the specimens were obtained is well within the area shown as metamorphic on the present geological map of the colony. Most of the specimens are a mere glaze on the surface of the rock, and are quite invisible except when held in a certain position with regard to the light. The two species identified, however, are sufficiently well preserved to enable enlarged drawings to be made under the camera. These are *Dicellograptus elegans*, Carr., and *Climacograptus bicornis*, J. Hall. Besides these there are two, or perhaps three, species of *Diplo-*

graptidæ, the characters of which are too obscure to permit of identification.

Tungamah.

No older rocks are mapped in the locality from which these specimens came. They are more conspicuous than those from the former locality, but the finer characters are in great part obscured through weathering. There are several which appear to be new, one perhaps generically, but they are too obscure to speak of with any definiteness. I query some of the species, as they are identified from the form and dimensions of the polypary only, the hydrothecæ not being visible. The following forms occur: *? Dicellograptus sextans*, J. Hall; *Dicellograptus* sp.; *? Dicranograptus ramosus*, J. Hall; *Diplograptus pristis*, Hisinger, and *Glossograptus*, sp.

Walwal Creek.

The district from which these specimens come is coloured as granite on the map. They are preserved merely as a glaze on the rock and, though unable to make camera drawings of them, I made careful sketches and measurements of those I have identified. Several forms of *Diplograptidæ* were too badly preserved to speak of definitely, but I have made out the characters of the following: *Dicellograptus anceps*, Nich.; *Diplograptus pristis*, His.; *Diplograptus truncatus*, Lapw.; *Climacograptus bicornis*, J. Hall.

It has of course long been known that the boundaries of the geological formations as laid down on the present Victorian map needed revision, especially in the area under notice, and the compilation of a new map by Mr. Arthur Everett from recent surveys is practically completed.

The age of the Lower Palæozoic rocks of North-eastern Victoria has, in the absence of fossils, been a matter of considerable doubt. Mr. A. W. Howitt in his earlier papers considered the balance of evidence in favour of Lower Silurian (Ordovician). The rocks show, according to Mr. Howitt, great structural and lithological resemblances to those to the east of the Snowy River, and from

this latter area he quotes, on the authority of Sir Frederick McCoy, *Diplograptus rectangularis*, McCoy, from Deddick; *Diplograptus foliaceus*, Murch., and *Didymograptus caduceus*, Salter from Guttamurrh Creek.* From the Gibbo River he quotes *Palæopora* sp., from the limestones and states that Sir Frederick McCoy regards this form to be indicative of the Upper Silurian age of the limestone. In a later paper† the same author, in speaking of the slates and sandstones of the Upper Dargo, says that they "have hitherto been provisionally regarded as Lower Silurian, but may possibly be found ultimately to be Cambrian." Although, from the nature of the case, Mr. Howitt speaks guardedly of the age of the strata, he has shown that part, at any rate, of the metamorphic schists are representatives of the unaltered sediments.‡

The three localities which have yielded the graptolites treated of in this paper are widely separated, but are, as far as can be judged, of nearly the same age, and may be referred to the higher part of the Ordovician. Till more evidence be available it would be rash to push the analogy to the succession in British rocks any further.

As far as I am aware there are no published records of any (Upper) Silurian fossils, other than the *Palæopora* referred to by Mr. Howitt, having been found in the area under consideration. Mr. Ferguson, however, informs me that he has a large suite of fossils from Wombat Creek which he considers to be (Upper) Silurian. The publication of his report will be looked for with interest.

It is of course possible that, in such a wide area as the one treated of, rocks older than these may occur, but of their occurrence we have no evidence whatever. Mr. A. W. Howitt in his long series of papers on the rocks of Eastern Victoria has shown that a gradual passage takes place from the unaltered rocks into the crystalline schists, and this fact taken in conjunction with the evidence here brought forward as to the geological age of the

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* Progress Report, Geol. Survey of Victoria, vol. iii., p. 186.

† "Notes on the Contact of the Metamorphic and Sedimentary Formations of the Upper Dargo River." Department of Mines, Special Reports, 1892, p. 3.

‡ Aust. Ass. for Adv. Science, vol. i., Sydney, p. 206.

unaltered sediments gives us sufficient grounds for considering the metamorphic rocks of North-eastern Victoria to be not older than Ordovician.

My thanks are due to Sir Frederick McCoy for allowing me access to several papers on graptolites, which are not to be found in any of our Victorian libraries; and also to Mr. W. H. Ferguson of the Geological Branch of the Mines Department, who collected the fossils I have examined.

Art. XIV.—*A Contribution to our Knowledge of the Tertiaries in the Neighbourhood of Melbourne.*

By T. S. Hall, M.A.,

Demonstrator and Assistant Lecturer in Biology in the University of Melbourne,

and

G. B. Pritchard,

Lecturer in Geology in the Working Men's College, Melbourne.

(Plate VIII.)

(Read 10th September, 1896).

Numerous scattered references have been made to the Melbourne Tertiaries in our Geological Literature, but hitherto no attempt has been made to describe them in any detail in the light of the more recent palæontological work that has been published. The lithological character of the sedimentary rocks of the period, consisting as they do, for the most part, of ferruginous sands and gravels, is not suited to the good preservation of fossils which are represented as a rule by casts, and to a lesser extent by usually very friable remains of the fossils themselves. As we have been collecting material and studying the beds in all parts of the area for some years, we feel that we are now in a position to make some substantial additions to the knowledge of the series and to clear away some misconceptions which prevail in reference to their age.

Historical.

We mention in chronological order the more important references to the deposits and the titles of a few additional papers will be found in the Literature at the end of the present article.

In 1855 Mr. A. R. C. Selwyn, (1) under the head of Tertiary, described the lithological character of the beds, indicating four divisions. He says that the blue clays with limestone bands appear to be the lowest portion of the tertiary series exposed in

the district; that they are rich in fossils, and that on the whole they bear a striking resemblance to the beds of the London clay and Hampshire basins. He says that in a well sinking at Prahran fossil shells were found in ferruginous sandstone, and also near Flemington overlying basalt. The beds were stated to bear a strong resemblance to the Crag of Suffolk, but the relation between the Flemington beds and those of Brighton was still uncertain. In dealing with the recent estuary beds, he says:—"Between Sandridge and Melbourne these beds have been proved to a depth of fifty feet, by a series of borings recently executed by Mr. Christie. In all the bores he has obtained recent shells, at various depths from the surface to about thirty feet; the accompanying section along the line of borings I have drawn from the data furnished by Mr. Christie, and on examination which he has kindly permitted me to make of the specimens obtained from each bore, at every one or two feet." The section shows tertiary beds under the estuarine series.

In the following year Mr. Wm. Blandowski (2) referred to what are apparently the ferruginous beds of Flemington as belonging to the "uppermost tertiary formation," and stated that the fossils are living species.

In the following year Mr. Selwyn (3) briefly described the localities and lithological character of the tertiary beds of the area indicated by the title of his paper, but made no subdivisions, classing together the consolidated sand dunes of Point Nepean, the ferruginous sands and gravels which are so widely spread, and the blue clays of Mornington. The succession of the beds was shown, the richest fossil localities were indicated and a list of some of the genera was given.

The four geological quarter-sheets, showing the boundaries of the different formations in the neighbourhood of Melbourne, were issued apparently early in 1860, and are indispensable to any one examining the district. The country round Brighton has not yet been surveyed in detail.

In 1872 Mr. R. Brough Smyth (4) summarised the work of the Geological Survey, and gave a table showing the accepted classification of the Victorian tertiaries as they had been from time to time interpreted by Sir Frederick McCoy. The Marine beds of Flemington were referred to the Pliocene, and the white

clays underlying the Older Volcanic at Flemington and Kensington to the Miocene, while the Schnapper Point beds were called Oligocene. He gave a section, showing the relations of the beds, from the Royal Park to the escarpment on the left bank of the Saltwater River. The volcanic rock at South Melbourne and West Melbourne is coloured on the quarter-sheets as Lower Volcanic—that is, Lower Newer Volcanic—and is so lettered except on Quarter-sheet 1, N.W., where the lettering is V.O., *i.e.*, Older Volcanic. Mr. Smyth showed that the volcanic rocks of these areas are of the same age as those on the west of the Moonee Ponds Creek, and are all "Older Volcanic." He then clearly described the basin of Port Phillip, pointing out the sequence of the beds accurately; but it must be borne in mind that the nomenclature is entirely different from that adopted by the authors of the present paper. Another point on which we differ from him is in the interpretation of the sandy beds capping the hill along the south-west front of Royal Park. Mr. Smyth regarded these as sand dunes, but they are, in our opinion, an integral part of the upper series of marine tertiary beds displayed in the railway cutting in Royal Park.

In 1875 Mr. R. Etheridge, jun. (5), incidentally described a cliff section near Mordialloc which had been visited by Aplin and himself some years previously. As to the age of the beds, he simply says that they had been "mapped by Mr. A. R. C. Selwyn as of Pliocene age."

In 1876, and during some succeeding years, Sir Frederick McCoy (6) repeatedly referred to the fossiliferous beds of the Brighton to Mordialloc coast and of Flemington. They were classed together as of Older Pliocene Age.

Some nine years later, Mr. Reginald A. F. Murray consolidated the work of previous observers in Victorian Geology and referred the Flemington and Brighton beds and the gravel of Flagstaff Hill to the Pliocene Age. (7 p. 13).

In 1888, Professor Ralph Tate (8) doubtfully classed the Cheltenham beds as Miocene.

In 1892, one of the present authors (11), acting on the advice Professor Tate, classed the Cheltenham beds as Eocene.

Early in the following year, Mr. T. S. Hart (12) gave the results of prolonged, careful examination of the rocks of the

Brighton coast. The reference to Pliocene age and identity with the Flemington beds was unquestioningly adopted. The rocks were divided lithologically into a fourfold series. The author stated that there is an unconformity in the beds. We have had the pleasure of going over the coast sections in company with Mr. Hart, and have examined some of these unconformities, which undoubtedly exist. The best we have seen exposed is at Red Bluff, Sandringham. We are not, however, inclined to attach much importance to these small local irregularities. The rapid alternations of sediment, the current bedding, and the occurrence of fossil trees, pointed out by Mr. Hart, imply conditions favourable to the deposition and removal of strata, which would produce unconformities, but would not indicate any difference in age. In most places the beds succeed one another with no appreciable break.

In the same year the authors (13) indicated that the Flemington beds were probably Eocene, and definitely referred the blue clays found by sinking and boring at Newport and Altona Bay to the Eocene.

Messrs. Tate and Dennant (15) definitely classed the Cheltenham beds as Eocene, and a few months later Professor Tate (16) again expressed the same view.

Localities.

1. *Beaumaris* (east of the Hotel).

This is the richest fossil locality that is exposed, and is probably the source of most of the fossils recorded from "Cheltenham" and "Mordialloc." A slight anticlinal brings up the deeper beds in which the fossils are most plentiful, the strike being parallel to the coast line. In the northern corner of the bay the eastern limb of the arch suddenly plunges at an angle of from 20° to 25° in the direction E. 25° S. A little further to the south-west the dip decreases somewhat and swings a little more to the southward, being E. 40° S. at 17°, so that the anticline has a slight pitch in a south-westerly direction. The beach floor has long been a favourite collecting ground, and sharks' teeth, cetotolites and fragments of bone were formerly very commonly found. Many years ago it was noticed that

these could be obtained *in situ* by sinking a couple of feet at low tide, but the band containing them is not exposed. Loose nodules of limestone occur on the beach mingled with ironstone pebbles, which form a coarse shingle. Many of the limestone nodules contain perfect casts of fossils, which are, as our list shows, all typical Eocene species. We have not spent much time in collecting these forms, and have not recorded any collected from holes sunk on the beach floor, but have confined our attention to the strata which crop out along the base of the cliff. An examination of the fossils obtained from the cliff justifies us in referring the exposed beds to Miocene age. There are a few species of which the range will be thus extended into the Miocene ; but if, on the other hand, the beds were regarded as Eocene, a very large number of the most characteristic Miocene fossils would have to be considered as common to both Miocene and Eocene on the evidence of this section alone. The band yielding teeth, bones and ironstone concretions will probably be found to mark the junction of the two formations, the Eocene beds occurring below it.

Some of the fossil bands are fairly rich in mollusca, but they are much decomposed as a rule, and the greatest care is requisite to obtain whole specimens. Still, we have obtained a fair number of species, and quite enough to determine the age of the beds.

The character of the beds, seen in cliff section, has been so carefully described by Mr. Hart (12) that further comment is almost unneccessary. Taken as a whole, they consist of quartzose sand, with a varying amount of argillaceous material, and, excepting near the top of the cliffs, are strongly ferruginous.

The following fossils have been obtained from the cliffs at this locality :—

Crustacea (*Cirripedia*).

? Balanus sp.

Echinodermata.

Lovenia forbesi, Woods and Duncan.

Cidaroid spines.

Zoantharia.

Placotrochus deltoideus, Duncan.

Placotrochus elongatus, Duncan.

Brachiopoda.

Terebratulina catinuliformis ?, Tate.
Magasella compta, G. B. Sowerby.

Lamellibranchiata.

Ostrea arenicola, Tate.
Placunanomia ione, Gray.
Pecten antiaustralis, Tate.
Modiola, n. sp.
Nucula tenisoni, Pritchard.
Nucula, n. sp. aff. N. morundiana, Tate.
Nucula, n. sp.
Leda woodsii, Tate.
Leda vagans, Tate.
Leda acinaciformis, Tate.
Leda, n. sp. aff. L. huttoni, T. Woods.
Leda, n. sp.
Limopsis belcheri, Adams and Reeve.
Pectunculus cainozoicus, T. Woods.
,, laticostatus, Quoy and Gaimard.
Cucullæa corioensis, McCoy.
Trigonia acuticostata, McCoy.
Crassatella, n. sp. aff. C. oblonga, T. Woods.
Crassatella, n. sp. aff. C. abbreviata, Tate.
Carditella polita, Tate.
Cardita calva, Tate.
,, solida, Tate.
,, compacta, Tate.
,, delicatula ?, Tate.
,, n. sp.
,, n. sp.
Lucina aræa ?, Tate.
,, sp.
Diplodonta sp.
Chione subroborata, Tate.
,, n. sp. aff. C. propinqua, T. Woods.
,, n. sp. aff. C. dimorphophylla, Tate.
Dosinia johnstoni, Tate.
Tellina æquilatera, Tate.
,, albinelloides, Tate.

Tellina, n. sp. aff. T. stirlingi, Tate.
Psammobia hamiltonensis, Tate.
Semele krauseana ?, Tate.
Mactra hamiltonensis, Tate.
Zenatiopsis angustata, Tate.
Myadora corrugata, Tate.
Myadora praelonga, Tate.
Corbula ephamilla, Tate.
Barnea tiara, Tate.
Brechites sp.

Gastropoda.

Triton, n. sp.
Voluta, n. sp.
Ancillaria orycta, Tate.
,, n. sp. ?
Harpa, n. sp. aff. H. abbreviata, Tate.
Cassis, n. sp.*
Pelicaria coronata, Tate.
Terebra additoides ?, T. Woods.
Cypraea leptorhyncha, McCoy.
,, n. sp.
Natica varians, Tate.
,, substolida, Tate.
,, subinfundibulum, Tate.
,, hamiltonensis, T. Woods.
Calyptræa crassa, Tate.
Crepidula unguiformis, Lamarck.
Turritella tristira, Tate.
,, acricula, Tate.
,, pagodula, Tate.
Rissoa, sp.
Bankivia maxima, Tate, m.s.
Leiopyrga sayceana, Tate.
Calliostoma, sp.
Cylichna, sp.

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* This species may possibly be the same as that recorded by Professor R. Tate, from Cheltenham, under the name of *Cassis textilis*, Tate. My examination of the shells has, however, inclined my opinion towards regarding the present fossil as specifically distinct from the Murray Cliffs shell.

Scaphopoda.

Entalis mantelli, Zittel.
" subtissura, Tate.
Dentalium bifrons, Tate.

Pisces.

Carcharodon megalodon, Agassiz.
" angustidens, Agassiz.
Oxyrhina, sp.
Notidanus, sp.
Lamna, sp.
Myliobates, sp.
Strophodus eocenicus, Tate.
Palate, aff. Diodon.
Vertebræ.
Otoliths.

Mammalia.

Whale, vertebræ, etc.
Cetotolites.

SUMMARY (CHARMAN'S ROAD END).

Crustacea	1
Echinodermata	2
Zoantharia	2
Brachiopoda	2
Lamellibranchiata	45
Gastropoda	24
Scaphopoda	3
Pisces	10
Mammalia	2
	91

In addition to the above, Professor Tate records the following species from Cheltenham :—

Natica subvarians, Tate.
" polita, T. Woods, forma typica, Tate.
" perspectiva, Tate.
Pelicaria clathrata, Tate.

Sir Frederick McCoy (6) has recorded the following species from Mordialloc in addition to those above mentioned :—

Pecten yahlensis, T. Woods.
Spondylus pseudoradula, McCoy.
Aturia australis, McCoy.
Physetodon baileyana, McCoy.

These probably came from the neighbourhood of Charman's Road.

2. *Beaumaris* (West of Hotel).

As at the previous locality, the rocks are mainly ferruginous earthy sandstones. In places where the beds are hard, beautifully sharp impressions of shells occur in profusion, while in others calcareous bands full of shells run for long distances. Unfortunately the fossils are very rotten, and it is difficult to obtain specimens which will bear removal. The commonest fossil in the ferruginous beds is *Lovenia forbesi*, which occurs in enormous numbers in a beautiful state of preservation.

Foraminifera.

Echinodermata.

† Orthologhus lineatus, Duncan (Temnechinus).
† Clypeaster gippslandicus, McCoy.
† Monostychia australis, Laube, forma loveni, Duncan.
Lovenia forbesi, Woods and Duncan.
† Pericosmus sp.*
Cidaroid spines.

Crustacea.

Crab chelæ.
? Balanus 2 spp.

Polyzoa.

Brachiopoda.

Terebratulina catinuliformis ?, Tate.
Magasella compta, G. B. Sowerby.

Lamellibranchiata.

† Ostrea manubriata, Tate.
„ arenicola, Tate.
† „ sp.

* Identified by Sir Frederick McCoy.

Placunanomia ione, Gray.
Pecten antiaustralis, Tate.
† ,, polymorphoides, Zittel.
† ,, Zitteli, Hutton.
Modiola, n. sp.
Nucula tenisoni, Pritchard.
,, n. sp., aff. N. morundiana, Tate.
Leda woodsii, Tate.
† ,, crassa, Hinds.
† ,, n. sp. 1.
† ,, n. sp. 2.
Limopsis belcheri, Adams and Reeve.
Pectunculus cainozoicus, T. Woods.
Trigonia acuticostata, McCoy.
Crassatella, n. sp., aff. C. oblonga, T. Woods.
,, n. sp., aff. C. abbreviata, Tate.
Cardita calva, Tate.
,, solida, Tate.
,, compacta, Tate.
† ,, spinulosa, Tate.
,, n. sp.
† Diplodonta suborbicularis, Tate.
† ,, crepidulæformis, Tate.
† ,, n. sp.
† Montacuta sericea, Tate.
† ,, n. sp.
Chione subroborata, Tate.
,, n. sp., aff. C. propinqua, T. Woods.
,, n. sp., aff. C. dimorphophylla, Tate.
† Meretrix paucirugata, Tate.
Dosinia johnstoni, Tate.
Tellina albinelloides, Tate.
,, æquilatera, Tate.
,, n. sp. aff. T. stirlingi.
† Donax, n. sp. aff. D. epidermia.
Mactra hamiltonensis, Tate.
Zenatiopsis angustata, Tate.
Myadora corrugata, Tate.
† ,, brevis, Sowerby.

Corbula ephamilla, Tate.
Barnea tiara, Tate.

Gastropoda.

† Trophon, n. sp.
† Pleurotoma, n. sp. ?
Pelicaria coronata, Tate.
Cassis, n. sp.
Natica varians, Tate.
Calyptræa crassa, Tate.
† Scalaria triplicata, Tate.
Turritella pagodula, Tate.
† Turbo, sp.
Bankivia maxima, Tate, m.s.
Leiopyrga sayceana, Tate.
† „ quadricingulata, Tate.

Scaphopoda.

Entalis subfissura, Tate.

Pisces.

Shark's teeth.

Mammalia.

Whale bones.

SUMMARY.

Echinodermata	6
Crustacea	3
Brachiopoda	2
Lamellibranchiata	44
Gastropoda	12
Scaphopoda	1
Pisces	1
Mammalia	1
	70

In the foregoing list the species marked by a dagger (†) are additional to those collected at the Charman's Road end of the section. They are as follows:—

Echinodermata	4
Lamellibranchiata	16
Gastropoda	5
	25

Total from Charman's Road (not including Tate's and McCoy's records - - - - - -	19
	116

In the above 116 records there are fifty-nine described molluscan species of which there are four recorded with a query until better material is obtained. So that for careful and critical comparison with specimens from our other fossil localities we can take into consideration fifty-five species.

Cheltenham Fossils.	Eocene.	Miocene.		
		Muddy Creek.	Jemmy's Point.	South Australia.
Gastropoda.				
Ancillaria oryeta, Tate - - -	x	-	x	x
Pelicaria coronata, Tate - - -	-	x	x	-
Cypraea leptorhyncha, McCoy - -	x	-	-	-
Natica varians, Tate - - - -	-	x	x	-
,, substolida, Tate - - -	x	-	x	-
,, subinfundibulum, Tate - -	x	x	x	-
,, hamiltonensis, Tate - - -	x	-	x	-
Calyptraea crassa, Tate - - -	-	-	x	x
*Crepidula unguiformis, Lamk. - -	x	x	x	x
Scalaria triplicata, Tate - - -	-	-	x	x
Turritella tristira, Tate - - -	x	-	x	-
,, acricula, Tate - - -	x	-	x	x?
,, pagodula, Tate - - -	-	-	x	-
Leiopyrga sayceana, Tate - - -	-	x	x?	-
,, quadricingulata, Tate - -	-	x	x	-
Scaphopoda.				
Entalis mantelli, Zittel - - -	x	x	x	-
,, subfissura, Tate - - -	x	x	x	-
Dentalium bifrons, Tate - - -	x	x	-	-
Lamellibranchiata.				
Ostrea arenicola, Tate - - -	-	-	x	x
,, manubriata, Tate - - -	-	x	-	-
*Placunanomia ione, Gray - - -	x	x	x	x
Pecten antiaustralis, Tate - - -	-	x	x	x
,, polymorphoides, Zittel - -	x	-	-	-
,, zitteli, Hutton - - -	x	x	-	-

Cheltenham Fossils.	Eocene.	Miocene.		
		Muddy Creek.	Jemmy's Point.	South Australia.
*Nucula tenisoni, Pritchard	x	x	x	x
Leda woodsii, Tate	x	x	-	-
* ,, crassa, Hinds	-	x	x	-
,, acinaciformis, Tate	-	x	-	-
,, vagans, Tate	x	-	x	-
*Limopsis belcheri, Ad. & R.	x	x	x	x
Pectunculus cainozoicus, T. Woods	x	x	x	-
* ,, laticostatus, Quoy & Gaim.	x	x	x	-
Cucullæa corioensis, McCoy	x	x	x	x
*Trigonia acuticostata, McCoy	-	x	x	x
Carditella polita, Tate	-	x	-	-
Cardita calva, Tate	x	x	-	-
,, solida, Tate	-	x	x	-
,, compacta, Tate	x	-	-	-
,, spinulosa, Tate	-	-	x	-
Diplodonta suborbicularis, Tate	x	x	-	x
,, crepidulæformis, Tate	x	-	-	-
Montacuta sericea, Tate	x	x	-	-
Chione subroborata, Tate	-	x	x	x
Meretrix paucirugata, Tate	-	x	x	-
Dosinia johnstoni, Tate	-	x	-	-
Tellina albinelloides, Tate	-	x	x	-
,, æquilatera, Tate	x?	x	x	-
Psammobia hamiltonensis, Tate	-	x	x	-
Mactra hamiltonensis, Tate	-	x	x	-
Zenatiopsis angustata, Tate	-	x	x	-
Myadora corrugata, Tate	-	x	x	x
,, prælonga, Tate	-	x	x	-
* ,, brevis, Sowerby	x	x	x	x
Corbula ephamilla, Tate	x	x	x	x
Barnea tiara, Tate	-	x	x	-

Note.—Those marked with an asterisk are living species.

Summary of vertical distribution of described mollusca from the Cheltenham cliffs.

Number of species in above list - -	55
Number of these in Eocene elsewhere	29 (1 doubtful)
Number of these in Miocene—	
Muddy Creek - - -	40
Jemmy's Point - - -	41 (1 doubtful)
South Australia - - -	17 (1 doubtful)
Number hitherto regarded as Eocene only - - - - - -	4*
Number of species common to Eocene and Miocene - - - -	25 (1 doubtful)
Number of species found only in Miocene and younger beds -	26

Beaumaris.

Eocene Fossils (from Limestone Shingle).

Zoantharia.

Placotrochus deltoideus, Duncan.

Notocyathus excisus, Duncan.

Polyzoa.

Brachiopoda.

Waldheimia insolita, Tate.

Lamellibranchiata.

Spondylus pseudoradula, McCoy.

Gastropoda.

Triton cyphus, Tate.

,, gibbus, Tate.

,, textilis ?, Tate.

Peristernia murrayana, ?, Tate.

Voluta hannafordi, McCoy.

,, antiscalaris, McCoy.

,, strophodon, McCoy.

,, sp. 1.

,, sp. 2.

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* *i.e.* except those recorded as Eocene on the strength of their occurrence at Cheltenham only.

Semicassis sufflata, T. Woods.
Cypraea leptorhyncha, Tate.
Conus ligatus, Tate.
,, cuspidatus, Tate.
Genotia angustifrons, Tate
Natica, sp.
Turritella murrayana, Tate.
Cerithium apheles, T. Woods.
Trochoid casts.

Cephalopoda.

Nautilus, sp.

One of the authors has elsewhere recorded thirty-two species of fossils from Cheltenham (11). As uncertainty exists as to the exact horizon from which the greater number were obtained, and as there is evidence that some species, hitherto regarded as Eocene, transgress at Cheltenham into the Miocene, it would, we think, be injudicious to attempt to correct the list there given. The only safe plan is to erase the record by striking out the word "Cheltenham" wherever it occurs in the catalogue. The locality is correct, the horizon may be surmised for most of the forms, but is not absolutely certain.

3. *Ricketts Point.*

Mr. J. A. Atkinson first drew our attention to the fossils occurring in ferruginous beds here. They are not common and as is usually the case are mere casts.

We have found the following:—*Lovenia forbesii*, Wds. and Dunc.; *Leda crassa*, Hinds; *Chione subroborata*, Tate; *Dosinia johnstoni*, Tate; *Tellina albinelloides*, Tate; *Mactra hamiltonensis*, Tate; *Donax*, sp.; *Zenatiopsis angustata*, Tate; *Barnea tiara*, Tate; *Scalaria triplicata*, Tate; *Leiopyrga quadricingulata*, Tate; *L. sayceana*, Tate.

4. *Red Bluff, Sandringham.*

The cliff is about eighty feet in height. The upper portion consists of about sixty feet of mottled sandy clay, which overlies the denuded surface of strongly ferruginous sandstones full of concretionary nodules. We have already mentioned that we do

not think that this unconformity indicates any appreciable lapse of time and that the whole cliff belongs to the same period of deposition. The ferruginous beds are well jointed and after keeping fairly horizontal for about 150 yards they slowly sink with a dip of about 7° and pass out of sight, the mottled upper beds coming down to sea-level. In the ferruginous beds there occur small lenticular sheets of a hard grey limestone. In our searches for fossils at this locality we have been kindly assisted by Mr. T. S. Hart and Mr. W. H. F. Hill, who have placed their material at our disposal.

We obtained the following fossils:—*Lovenia forbesii*, Wds. and Dune.; *Leda crassa*, Hinds: *Chione subroborata*, Tate; *Dosinia johnstoni*, Tate: *Tellina albinelloides*, Tate; *Mactra hamiltonensis*, Tate: *Modiola*, sp. nov.: *Meretrix paucirugata*, Tate: *M. submultistriata*, Tate: *Zenatiopsis angustata*, Tate; *Entalis subfissura*, Tate; *Leiopyrga quadricingulata*, Tate; *L. sayceana*, Tate: *Bankivia maxima*, Tate, m.s.: *Potamides*, sp., *Calyptraea crassa*, Tate.

5. *Hampton* (Picnic Point).

On the point south of the pier the hard ironstone is brought up by a slight roll in the strata, the strike of which is S.25°E., the dip being about 5°. Some of the bands are fairly rich in fossils.

6. *Brighton Beach.*

Casts of fossils occur in ferruginous beds at the mouth of a gully about half-way between Picnic Point and Brighton Beach.

7. *Brighton Beach.*

The point north of the pier at Brighton is formed by an outcrop of brown jointed sandstone passing up into mottled sandy clays. The rocks are slightly current bedded, and though fossils occur they are scarce. The dip as plotted from two observed apparent dips is N.11°E. at 13°.

8. *Brighton Beach.*

The locality is on the same low bluff as seven and on the north side of the point.

9. *Park Street, Brighton.*

Casts are common in ferruginous beds on the beach at the end of a point south of the North Brighton Baths. Mr. T. S. Hart drew our attention to this locality, which he records in his paper (12). *Leda crassa*, Hinds; *Dosinia johnstoni*, Tate; *Mactra hamiltonensis*, Tate; *Leiopyrga sayceana*, Tate; etc.

10. *Bay Street, Brighton.*

Casts in ferruginous sandstones on the beach.

11. *Park Street, Elsternwick.*

This is the most northerly locality in which we have found fossil casts in the beach exposures.

The rocks of Point Ormond (Red Bluff, St. Kilda) do not seem to contain any organic remains which seem to be confined to the deeper seated deposits of the series. A small outlier at the entrance to Kenney's Baths at the end of Fitzroy Street composed of a quartz conglomerate cemented with limonite seems similarly barren. The only sign of the beds to the north of this on the beach is a small patch of shingle near the Middle Park Baths.

12. *Asling Street.*

We found numerous casts in a heap of rock removed during the making of a road which runs from Asling Street towards the beach just before the latter crosses the small creek which runs into the Elwood Swamp. Mr. Hart kindly made enquiries and found that the material all came from the excavation beside which it lay.

Dosinia johnstoni, Tate; *Leda crassa*, Hinds; *Mactra hamiltonensis*, Tate; *Leiopyrga sayceana*, Tate; etc.

13. *North Road.*

Mr. G. Cuming gave us some blocks of fossiliferous ironstone which he obtained from a quarry near the Brighton Cemetery. We have not visited this locality.

Fossils.—*Leda crassa*, Hinds; *Leda*, sp.; *Mactra hamiltonensis*, Tate; *Myadora corrugata*, Tate; *Chione*, sp.? *aff. C. propinqua*, T. Wds.; *Leiopyrga sayceana*, Tate; *Bankivia maxima*, Tate, m.s.

14. *Windsor.*

We carefully examined the Tertiary grits overlying the Silurian in the railway cutting under the Dandenong Road at Windsor, but were not successful in finding any fossils. However, in a collection presented by the Mining Department to the Working Men's College are some samples of a ferruginous sandstone containing a few fossil casts and labelled "Railway Cutting, Windsor." We have no reason to doubt the correctness of the label, as a part of the cutting is now inaccessible owing to a retaining wall having been built.

Fossils obtained :—*Polyzoa : Spondylus pseudoradula*, M'Coy ; *Cardita polynema*, Tate; *Barbatia simulans*, Tate; *B. celleporacea*, Tate ; *Lima linguliformis*, Tate ; *L. bassii*, T. Woods ; *Phos tardicrescens* ?, Tate.

15. *South Yarra.*

The low platform of rock left in the angle formed by the junction of the Gippsland and Brighton Railways is in parts very full of casts and we were fortunate in obtaining some large blocks which were very rich and which we carried home bodily for careful examination. Although the fossils are so different from those hitherto dealt with, with the exception of those from Windsor, the lithological character of the matrix is similar to that of the previous sections. We have not found any fossils in the rocks overlying the platform nor have we been able to detect any physical break between them. The upper beds are usually mottled sands, but in places are as strongly cemented by iron as are the lower ones. An examination of the sections along the line towards Hawksburn and towards Prahran does not appear to throw any light on the difficulty. We are inclined, in view of the section in Royal Park, described below, to think that a distinct palæontological break will be yet found and that the upper beds are really a part of the series exposed along the Brighton coast.

Zoantharia.

Coral casts.

Crustacea.

Crab carapace.

Polyzoa.

Brachiopoda.

Waldheimia garibaldiana, Davidson.

Lamellibranchiata.

Placunanomia, sp.
Pecten hochstetteri, Zittel.
„ polymorphoides, Zittel.
Lima bassii, T. Woods.
„ linguliformis, Tate.
Spondylus pseudoradula, McCoy.
Modiola, sp.
Leda vagans ?, Tate.
Pectunculus laticostatus, Quoy and Gaimard.
„ cainozoicus, T. Woods.
Barbatia simulans, Tate.
„ celleporacea, Tate.
Plagiarca cainzoica, Tate.
Limopsis belcheri, Adams and Reeve.
Chione cainozoica, T. Woods.
Cardita polynema Tate.
Chama lamellifera ?, T. Woods.

Gastropoda.

Fusus craspedotus ?, Tate.
Nassa tatei ?, T. Woods.
Lyria harpularia, Tate.
Ancillaria pseudaustralis, Tate.
Conus heterospira, Tate.
Cypræa, sp.
Trivia avellanoides, McCoy.
Semicassis sufflata, T. Woods.
Natica hamiltonensis ?, T. Woods.
Calyptropsis turbinata, T. Woods.
Cerithium flemingtonensis, McCoy.
Liotia roblini, Johnston.
Astralium (Imperator) johnstoni, Pritchard.
Haliotis nævosoides, McCoy.

Scaphopoda.

Entalis mantelli, Zittel.
„ subfissura, Tate.

16. *Domain Road, South Yarra.*

A shaft sunk during the progress of the sewerage works near the Grammar School Chapel, yielded casts of a few gastropods, a small bivalve, some polyzoa and foraminifera. We were unable to determine any of the specimens. The depth at which they were struck was about twenty feet below the level of the South Yarra Railway line, judging by the plans kindly shown us by the overseer of the works. A drab tenacious clay occurred below the ferruginous beds, but did not appear to contain fossils. The sewer itself was driven in Silurian.

17. *Royal Park.*

The Railway Cutting in Royal Park, close to Flemington Bridge, is, from a geological point of view, one of the most interesting and instructive spots in the neighbourhood of Melbourne. At the south-western end beneath the semaphore at the level of the rails is a small exposure of the lowest rocks to be seen in the district, the Upper Silurian. When the cutting was new and the exposure fresh, the bedding planes were distinctly visible, although at the present time the nature of the rock is not so manifest. Flanking this ridge on its south-western side is the older volcanic rock. This is deeply eroded and two or three other exposures of it weathered to a soft, wackenitic clay, are visible in the cutting. In the hollows of its upper surface are pockets of sand and clay. The largest exposure of these rests in its lower part on the north-eastern flank of the Silurian ridge just mentioned and thins out on the volcanic rock. Immediately over the thin sheets of white sand and clay there is a bed about a foot in thickness of similar material cemented with oxide of iron mainly in the form of red ochre, which in places passes into hard hematite.

This band is not separable from the clays and sands on which it rests. The cement penetrates the lower layers irregularly so that at first sight an unconformity suggests itself. This appearance is, however, entirely due to the irregular occurrence of the cementing material. The absence of the cement from the underlying beds may be due to one of two causes. If the iron were ever in the beds it may have been removed by the percolation of meteoric water slowing draining along the old channel

in the volcanic rock which affords an impervious bottom. If this were the case we should expect the base of the ferruginous beds to contain limonite and the more hydrated forms of iron oxide. This is, however, not what we do find. The hematite stops suddenly, though in places somewhat irregularly, and is immediately succeeded in depth by the white sands. The other explanation, and the one which we are inclined to accept is that the iron has all come from the beds above and has been prevented from reaching the lower beds by a band of clay through which the water with iron in solution could not percolate.

The presence of the hematite cement which marks off the highly fossiliferous band from the limonite bearing beds above, together with the fact that the characteristic fossils which it contains do not rise over the bosses of volcanic rock, but lie in its eroded hollows, would in themselves afford some slight evidence of its distinctness from the overlying beds. That there is a real break the fossil evidence clearly shows. The fossils of this lower band are Eocene while those of the beds above it are Miocene.

The uppermost beds displayed in the cutting form the table-land of Royal Park. They have been removed by subsequent denudation at the south-westerly end of the cutting where the surface of the ground drops rapidly. The material of which they consist varies from quartz gravel to fine sand with a large proportion of clay. The lower beds of this upper series, as a rule, are more strongly cemented by limonite than are the upper ones, in which the ferruginous material occurs very irregularly. Towards the top of the cutting the beds are in places almost free from iron which has been irregularly removed. Fossils are very scarce, but we have gathered a few forms which are so characteristic that there cannot, to our minds, be any doubt of the horizon to which the beds should be referred. The quarter-sheet records "fossil leaves and fruit in tertiary ferruginous sandstone" from this locality. We have not found any traces of these at this spot but believe them to have come from the upper beds.

LOWER BEDS (*Eocene*).

Echinodermata.

Psammechinus woodsi, Laube.

? Toxobrissus sp. (also at Schnapper Point, Moorabool Valley and Waurn Ponds).

Cidaroid spines.

Crustacea.

Crab carapace and chelæ.

Polyzoa.

Brachiopoda.

Waldheimia garibaldiana, Davidson.

„ insolita, Tate.

Lamellibranchiata.

*Placunanomia, sp.

Lima bassii, T. Woods.

* „ linguliformis, Tate.

„ (Limatula) jeffreysiana, Tate.

Spondylus pseudoradula, McCoy.

Nucula tenisoni ?, Pritchard.

*Barbatia celleporacea, Tate.

„ simulans, Tate.

Cucullæa corioensis, McCoy.

Cardita polynema ?, Tate.

* „ delicatula ?, Tate.

Mytilicardia, sp.

Chione dimorphophylla, Tate.

„ cainozoica, T. Woods.

*Corbula ephamilla, Tate.

Gastropoda.

*Triton, sp.

Fasciolaria rugata, Tate.

Voluta ancilloides, Tate.

„ sp. (? McCoyii, T. Woods).

Pleurotoma paracantha, T. Woods.

Drillia, sp.

Genotia angustifrons, Tate.

Conus ligatus, Tate.

„ heterospira ?, Tate.

Cypræa subsidua, Tate.

„ brachypyga, Tate.

„ sp.

Trivia avellanoides, McCoy.

*Harpa tenuis, Tate

„ n. sp.

Cassis exigua, T. Woods.

*Calyptræa, sp.
Natica, sp.
Solarium, sp.
Scalaria, sp.
Tenagodes occlusus, T. Wds.
*Thylacodes conohelix, T. Woods.
Cerithium flemingtonensis, McCoy.
*Triforis, sp.
Astralium (Imperator) johnstoni, Pritchard.
Turbo flindersi ?, T. Woods.
Opercula of Turbo.
Calliostoma, sp.
Haliotis naevosoides, McCoy.
,, mooraboolensis, McCoy.
*Emarginula, sp. aff. E. candida, A. Adams.
* ,, n. sp. 1.
,, n. sp. 2.
Acmæa, sp. aff. A. costata.

Scaphopoda.

Entalis mantelli, Zittel.

Cephalopoda.

Aturia australis, McCoy.

NOTE.—The species marked by an asterisk were collected by Mr. A. W. Craig, M.A.

UPPER BEDS (*Miocene*).

Leda acinaciformis, Tate.
Limopsis belcheri, Adams & Reeve.
Dosinia johnstoni, Tate.
Myadora corrugata, Tate.
Tritonidea brevis, Tate.
Terebra geniculata, Tate.
,, catenifera, Tate.
Turritella, sp.
Pyramidella, sp.
Leiopyrga quadricingulata, Tate.
Liotia, sp.
Entalis subfissura, Tate.

And other indeterminate univalve and bivalve casts.

18. *Sutton Street.*

At the west end of Sutton Street, North Melbourne, an outcrop of white clay is visible along the bank of the swampy land. This is marked on the quarter-sheet and is perhaps one of the localities from which Brough Smyth obtained fossil leaves, as he only gives his locality in a general way. We were unable to find any fossils in the deposit. The beds are well stratified and consist for the most part of white clays which are however very sandy in places, the sand being very coarse. It contains large ferruginous concretions and irregular masses of fine dark coloured translucent flint. Its eroded surface is covered by the older volcanic rock. These clays represent the Miocene of Brough Smyth's section (4).

19. *Flemington.*

At the top of the opposite escarpment across the Moonee Ponds Valley a small excavation yielded a few forms similar to those of the lower beds of the Royal Park cutting.

20. *Brunswick Road.*

The ferruginous grits overlying decomposed volcanic rock in the road cutting to the west of the Moonee Ponds Creek are fossiliferous, though the variety of forms does not seem to be very great. Mr. G. Sweet drew our attention to the occurrence of fossil leaves in some of the upper beds in the cutting, and on a visit in his company we were able to secure evidence of their occurrence.

Placunanomia, sp.
Leda acinaciformis, Tate.
,, sp.
Modiola, sp.
Chione, n. sp. aff. C. propinqua, T. Woods.
Cytherea paucirugata, Tate.
Mactra hamiltonensis, Tate.
Zenatiopsis angustata, Tate.
Corbula ephamilla, Tate.
Peristernia approximans, Tate.
Ancillaria pseudaustralis, Tate.

Natica varians, Tate.
Hipponyx antiquatus ?, Lamarck.
Pyramidella, sp.
Leiopyrga quadricingulata, Tate.
,, sayceana ?, Tate.
Emarginula, sp.
Haliotis, n. sp. aff. H. nævosoides, McCoy.

21. *Spring Creek.*

This small creek enters the Saltwater River between Braybrook and Maribyrnong. It flows through plains capped by newer volcanic rock, and has cut through this to the underlying formations. On the quarter-sheet a fault is marked crossing it and lowering the newer to the level of the old volcanic rock in the creek bed. The upper volcanic, wherever it is visible in cliff section in the neighbourhood, is seen to be formed by a very thin flow, and to assume that after faulting the surface had been planed down to its present level contour is hardly, we think, justified. An examination of the locality induced us to form the opinion that the appearance is due, not to faulting, but to the presence of an old valley crossing the present one obliquely. This old valley subsequently became filled with lava which formed the plain. The fossils found were indeterminate.

22. *Green Gully, Keilor.*

The beds in this pretty little glen are indicated on the quarter-sheet and have been briefly alluded to by Mr. Graham Officer (14). Aneroid measurement shows that the depth of the valley where the road crosses it is about 130ft. The section here is approximately as follows, the thickness of the individual beds being estimated :—

Newer volcanic rock - - -	20 feet.
Quartzites and grits - - -	25 ,,
Ferruginous grits (fossiliferous) -	20 ,,
Older volcanic - - - -	65 ,,
	130 feet.

A few yards above the road on the right bank the ferruginous grits are in their lower part replaced by a band of cream coloured, earthy, polyzoal limestone about five feet thick. It is full of foraminifera, echini spines and polyzoa, though, as is usually the case in such rocks, other fossils are scarce. In patches the limestone is altered to a fine grained, hard, reddish rock with a conchoidal fracture. The limestone is immediately succeeded in depth by decomposed volcanic rock seamed with sheets of secondary ironstone. The limestone is very quartzose in places and passes up gradually into ferruginous grit, in which we have not been able as yet to find any fossils.

The alteration of the limestone overlying the volcanic rock here is of interest when taken into consideration with similar developments elsewhere. At Maude the alteration is so pronounced in places that the officers of the survey were led to ascribe it to the effect of an overlying thin sheet of volcanic rock. We have shown in a previous paper (17) that there is no intercalated basalt, and that the appearances which suggest its presence are really due to the deposition of the limestone in the clefts and crannies of a denuded basalt surface. The alteration cannot then have been produced as suggested. In fact the same section shows similar polyzoal limestones overlain by 100 feet of basalt, but no marked changes have been brought about by the flow. We noticed that at Maude the alteration of the rock was most pronounced where it lay on the denuded basalt surface, and became less marked at higher levels, but were quite at a loss to account for it.

Since then we have examined similar altered polyzoal limestones at Airey's Inlet where it lies on the denuded surface of the great basaltic dykes which seam the ash beds and on the ash beds themselves. Again at Point Addis we have the pink finely crystallised limestone passing up into the usual loose-textured polyzoal rock. The limestone rests on a great thickness of remarkable black clays. In the Grange Burn, near Hamilton, we find a similar limestone highly altered and plastered down into the joints and irregularities of the porphyry where the latter crosses the stream. Further removed from the junction of the two formations the alteration is less pronounced. Similar alteration is found in the polyzoal rock overlying ash beds at Curlewis

and near Batesford where the granite probably underlies at no great depth.

There is one feature in common to all these cases, and that is the comparative imperviousness of the bed rock, whether it be porphyry, basalt, decomposed ash or sedimentary clay. The typical polyzoal limestone is very open and porous, and it consequently offers a free channel to the passage of underground waters, which would accumulate in them in such localities and thus bring about the solution and redeposition of the calcareous matter and so destroy in places all evidence of organic contents. Mr. A. W. Howitt (18, p. 209), mentions a similar alteration in Devonian limestone, which a previous writer had explained as due to the intrusion of an igneous rock. Mr. Howitt shows that the limestone in question was laid down on a shingly bottom and ascribes the alteration to the infiltration of silica set free during the decomposition of the porphyry beneath.

In the road cutting on the opposite side of the valley the junction of the tertiary beds with the underlying volcanic rock is well displayed. The upper surface of the latter is very uneven and the rock is quite wackenitic. Immediately resting on it is a bed of chocolate-coloured grit about five feet in thickness which yielded us a few fossil casts.

We found *Haliotis nævosoides*, M'Coy, and a shark's tooth, possibly *Lamna*.

This bed is overlain by about four feet of fine grained yellow sandstones which are current-bedded. Over this again come thin beds of water-worn gravel. Over a wide area in this locality overlying the fossiliferous beds we have a bed of sandstone and gravel, which in some places is loose and incoherent, and in others is cemented so as to be a hard white quartzite. The finer varieties look like porcelain. Of the equivalents of the beds over the fossiliferous grits we are uncertain, as we have not been able to get a junction between the two sets. We, however, class them, provisionally, with the Miocene series till further evidence be forthcoming.

Foraminifera.

Echinodermata. Spines and cidaroid plates.

Polyzoa.

Brachiopoda.

Waldheimia garibaldiana, Dav.
Rhynchonella squamosa, Hutton.
Terebratulina scoulari, Tate.

Lamellibranchiata.

Limea linguliformis, Tate.
Pecten foulcheri, T. Woods.
Chione cainozoica, T. Wds.
Chama lamellifera, T. Wds.
Spondylus pseudoradula, M'Coy.

Gastropoda.

Haliotis nævosoides, M'Coy.
Cerithium flemingtonensis, M'Coy.
Conus ralphii, T. Wds.
Trivia avellanoides, M'Coy.
Mitra alokiza, T. Wds.
Turritella murrayana ?, Tate.
Potamides, sp.
Voluta ancilloides, Tate.
Ancillaria pseudaustralis, Tate.
Astralium johnstoni, Pritchard.
Turbo, sp.
Semicassis sufflata T. Wds.
Tenagodes occlusus ?, T. Wds.

Scaphopoda.

Dentalium bifrons, Tate.

Pisces.

Shark's teeth.

Mammalia.

Bones of, ? Whale.

23. *Newport.*

Several bores have been put down and a shaft sunk in search of coal. Particulars of the shaft and one bore, together with samples of the cores, have kindly been placed at our disposal by Mr. G. D. Barker. Details of another bore will be found, together with a locality plan, in the Report of the Secretary for

Mines for 1894. The beds of course vary in thickness in the different localities. The series may be taken as follows :—

1. Newer Volcanic - - - - - - - - 60 feet
2. Marine Tertiaries. The upper part ferruginous sands and yellow clays, which are unfossiliferous. The lower part yellow and gray clays with hard limestone bands (Eocene fossils) - - - - - - 120 feet
3. Estuarine and freshwater beds, composed of sands, clays, fine and coarse conglomerates, with seams of brown coal - - - - - 190 feet
4. Silurian (bored into for over 70 ft.).

Most of the fossils recorded were obtained from the spoil heap of the shaft.

Foraminifera.

Very common.

Porifera.

Spicules abundant.

Zoantharia.

Notocyathus, sp.
Flabellum victoriæ, Duncan.
,, candeanum, Edwards & Haime.
Placotrochus deltoideus, Duncan.

Polyzoa.

Very common.

Brachiopoda.

Terebratulina scoulari, Davidson.
Terebratula vitreoides, Tate.

Lamellibranchiata.

Ostrea, sp.
Dimya dissimilis, Tate.
Lima bassii, T. Wds.
Spondylus pseudoradula, McCoy.
* Nucula atkinsoni, Johnston.
,, tenisoni, Pritchard.
Leda huttoni, Tate.
,, obolella, Tate.
,, woodsii ?, Tate.
,, vagans, Tate.

Leda, n. sp.
Limopsis belcheri, Ad. & R.
Arca, n. sp.
Barbatia celleporacea, Tate.
Cucullæa corioensis, McCoy.
Trigonia tubulifera, Tate.
Cardita polynema, Tate.
Chione cainozoica, T. Wds.
Cytherea eburnea, Tate.
Semele krauseana, Tate.
,, vesiculosa, Tate.
Myadora tenuilirata, Tate.
Corbula ephamilla, Tate.
,, pixidata, Tate.
†‡ Capistrocardia fragilis, Tate.

Gastropoda.

Typhis acanthopterus, Tate.
Murex lophoessus, Tate.
Triton textilis, Tate.
,, tortirostris, Tate.
,, woodsii, Tate.
Fusus craspedotus, Tate.
,, acanthostephes, Tate.
‡ ,, senticosus, Tate.
† ,, hexagonalis, Tate.
Latirofusus, sp.
Clavella bulbodes, Tate.
Fasciolaria exilis, Tate.
† Siphonalia, sp., aff. longirostris, Tate.
Phos, ? variciferus, Tate.
Nassa tatei, T. Wds.
Voluta antiscalaris, M'Coy.
,, pseudolirata, Tate.
,, hannafordi, M'Coy.
,, sarissa, Tate.
† ,, strophodon, M'Coy.
Mitra alokiza, T. Wds.
,, ligata, Tate.
Marginella propinqua, Tate.

Marginella wentworthi, T. Wds.
„ micula, Tate.
Ancillaria pseudaustralis, Tate.
„ semilævis, T. Wds.
„ n. sp.
Columbella clathrata, Tate, m.s.
„ 3 spp.
Cancellaria varicifera, T. Wds.
Pleurotomidæ, 19 spp.
Genotia angustifrons, Tate.
Pleurotoma samueli, T. Wds.
Conus dennanti, Tate.
Cypræa leptorhyncha, M'Coy.
Semicassis sufflata, T. Wds.
* Cassidaria gradata, Tate.
Natica hamiltonensis, T. Wds.
„ substolida, Tate.
Xenophora tatei, Cossmann.
Solarium acutum, T. Wds.
Turritella platyspira, T. Wds.
„ murrayana, Tate.
„ acricula, Tate.
„ sp.
Thylacodes conohelix, T. Wds.
Niso psila, T. Wds.
* Odostomia, n. spp. (2).
Cerithium apheles, T. Wds.
„ cribarioides, T. Wds.
‡ „ ? n. sp.
‡ Cerithiopsis, 2 spp.
Triforis wilkinsoni, T. Wds.
„ n. sp.
† „ n. sp.
* Actæon, sp.
Ringicula, sp.
Cylichna, 2 spp.

Scaphopoda.

Entalis mantelli, Zittel.
„ subfissura, Tate.
Dentalium aratum, Tate.

Pteropoda.

Styliola rangiana, Tate.

Pisces.

Otoliths.

SUMMARY.

Zoantharia - - - - -	4
Brachiopoda - - - - -	2
Lamellibranchiata - - - -	25
Gastropoda - - - - -	82
Scaphopoda - - - - -	3
Pteropoda - - - - -	1
Pisces - - - - - -	1
	118

* Species collected by Mr. E. J. Robertson.
† Species collected by Mr. A. E. Kitson.
‡ Species collected by Mr. Graham Officer.

24. *Altona Bay.*

A bore was put down, some particulars of which, with locality plan, are published in the Report of the Secretary for Mines for 1894. Practically the same series of rocks was exposed as at Newport. The thin sheet of volcanic rock however was overlain by about twenty feet of post tertiary rocks, containing an abundance of recent shells. The Marine tertiaries were about 160ft. in thickness. Beneath the freshwater beds, the Government report states that "45ft. 10in. fine white quartz-drift mixed with shells" occurred. Unfortunately no sample of this interesting deposit was sent to the department nor could we find any trace of it when visiting the locality. It was probably too incoherent for a core to be drawn, so that the interesting question as to what the fossils were will probably remain unknown as the bed lies more than twenty feet below the brown coal seam. Silurian was struck at 422 feet.

The small amount of material, which consisted merely of drill cores, which we had to work on prevents the list of fossils from being larger. Some of the beds were very rich, and in some places the core was quite full of siliceous sponge spicules.

Foraminifera.

Excessively abundant.

Porifera.

Spicules very common. The siliceous forms comprise highly compound varieties.

Zoantharia.

Notocyathus excisus, Dunc.

,, australis, Dunc.

Balanophyllia australiense, Dunc.

Echinodermata.

Cidaroid spines.

Annelida.

Ditrupa, sp.

Polyzoa.

Very common.

Brachiopoda.

Waldheimia garibaldiana, Dav.

Terebratula vitreoides, Tate.

Terebratulina scoulari, Tate.

Lamellibranchiata.

Pecten zitteli, Hutton.

,, dichotomalis, Tate.

Lima (Limatula) jeffreysiana, Tate.

Modiolaria singularis, Tate.

Leda vagans, Tate.

,, huttoni, T. Wds.

,, obolella, Tate.

Limopsis belcheri, Ad. & R.

Cucullæa corioensis, M'Coy.

Chione cainozoica, T. Wds.

Cardita delicatula, Tate.

Carditella lamellata ? Tate.

Semele vesiculosa, Tate.

Corbula pixidata, Tate.

Cuspidaria subrostrata, ? Tate.

Gastropoda.

Murex trochispira, Tate.

Triton woodsii, Tate.

,, textilis, ? Tate.

Epidromus tenuicostatus, T. Wds.

Fusus foliaceus, Tate.

Fusus craspedotus, Tate.
Nassa tatei, T. Wds.
Marginella micula, Tate.
,, propinqua, Tate.
,, wenthworthi, T. Wds.
,, n. sp.
Ancillaria semilævis, T. Wds.
Columbella, sp.
Conus heterospira, Tate.
Pleurotoma murndaliana, T. Wds.
Pleurotoma, 3 spp.
Drillia, 3 spp.
Genotia angustifrons, Tate.
Cypræa leptorhyncha, M'Coy.
Cassidaria gradata, Tate.
Turritella platyspira, T. Wds.
,, conspicabilis, Tate.
,, acricula var., Tate.
,, sp.
Tenagodes occlusus, T. Wds.
Eulima, 2 spp.
Cerithium crebariodes, T. Wds.
? Cerithiopsis, sp.
Triforis, sp.
? Astele, sp.
Timostoma parvula, T. Wds.
Scaphander fragilis, Tate, m.s.
Cylichna, 3 spp.
Ringicula, sp.
Actæon, sp.

Scaphopoda.

Entalis mantelli, Zittel.
,, subfissura, Tate.
Dentalium aratum, Tate.

Pteropoda.

Vaginella eligmostoma, Tate.
Styliola rangiana, Tate.
Spiralis tertiaria, Tate.

Pisces.

Otoliths.

SUMMARY.

Zoantharia - - - - -	3
Echinodermata - - - -	1
Annelida - - - - -	1
Brachiopoda - - - - -	3
Lamellibranchiata - - - -	15
Gastropoda - - - - -	42
Scaphopoda - - - - -	3
Pteropoda - - - - -	3
Pisces - - - - -	1
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The Geological Structure of the District.

Having now considered the fossiliferous localities of the Tertiary Rocks we shall make a few remarks on the structure of the area.

Upper Silurian.

The bed rock wherever exposed is Upper Silurian. There has been no attempt to work out in the field the stratigraphical relationships of the different fossiliferous outcrops of these rocks, and very little, comparatively, has been published on the organic remains. There is evidence, as will be shown below, that these rocks are intruded by granitoid rocks, and that extensive outcrops of the latter formerly occurred.

The Lower Leaf Beds, and Brown-Coals.

An outcrop of these from under the Older Volcanic Rock at North Melbourne has been noticed above, though, so far, we have found no fossils in it. Brough Smyth records another outcrop at Footscray, and the beds are indicated as occurring near the Industrial Schools in Royal Park.

These beds thicken very much to the south-west where they are represented by the brown-coal deposits of Newport and Altona Bay. The age indicated for the northern members of these beds on the quarter-sheet is Pliocene. Brough Smyth (4) gave reasons for considering them to be Miocene, and his classifi-

cation is adopted by Murray (7). We have elsewhere (19) given reasons for considering them to be very early Eocene or Cretaceous.

The Older Volcanic.

We have elsewhere shown that the age of these rocks is Eocene (17). The area covered can be seen on referring to the quarter-sheets, the outcrops being confined to the central and north-western part of the district under consideration.

At Mentone a bore for water was put down which is stated to have reached Silurian at a depth of 583ft. No basalt was found in the bore. Fossils occurred at 86ft.; 150ft.; 235ft.; 253ft.; but none were preserved. We have to thank Mr. G. D. Barker, for the particulars.

At Mordialloc another bore put down for the same purpose in 1887 reached basalt at 223ft., and it was bored into for a distance of 17ft. when operations were suspended.

At Frankston again the Volcanic Rock was struck under tertiaries at a depth of 250ft. (4). It covers a large part of the Mornington Peninsula, and the country to the eastward.

Marine Eocene.

The evidence put forward in the present paper shows that we may consider the following beds as Eocene—the grey clays and limestone of Altona Bay and Newport, the polyzoal limestone and the ferruginous beds indicated at Keilor, the lower beds at Royal Park and those facing them at Flemington, lower beds at South Yarra, ? Windsor, and the unknown beds from which the limestone shingle of the Beaumaris Beach is derived. The deposits at Altona Bay and Newport were unknown to the old survey, while the others were, with perhaps the exception of the polyzoal rock at Keilor, which was merely classed as Tertiary, grouped with the other ferruginous beds as Pliocene. The Eocene beds of Royal Park, Flemington and Green Gully are evidently littoral, while the finer nature of the sediment, and the great abundance of sponge spicules in the deposits at Altona Bay suggest deposition in deeper water.

Miocene.

An examination of the list of fossils from Cheltenham leaves little room for doubt that the deposit must be regarded as of the same age as the upper beds of Muddy Creek and Jemmy's Point.

With the Cheltenham beds must be grouped all the others from which we have recorded fossils in the present paper, with the exception of those above indicated as Eocene. Overlying these beds we have a series of sandstones and gravels which, wherever seen in the district south-east of Melbourne, appear to be inseparable from the underlying fossiliferous Miocene. Towards the north these deposits thin out on the flanks of the Silurian and are probably in the main of freshwater origin. To the south-east they are overlain by the still more recent deposits of Carrum Swamp and reappear beyond its southern boundary. They cover a large part of the northern portion of the Mornington Peninsula, where they can be seen in fine cliff section unconformably overlying the Marine Eocene. Similar rocks reappear in the Bellarine Peninsula (11). The survey grouped these rocks together and referred them to the Pliocene. At South Yarra, and if the locality reference of the fossils be correct, at Windsor, we have some difficulty in deciding whether the Eocene has or has not, a Miocene cover. Provisionally, however, we may group the superficial rocks of this area with the rest of the Miocene. Similarly to the north and north-west of Melbourne there is, in places, considerable difficulty in separating the Eocene from the Miocene beds. Probably the Eocene does not extend further north than the line from Royal Park to Keilor. As shown by the bores at Altona Bay the Eocene thickens towards the south. It thins out to the north where it is covered by the Miocene which overlaps and runs far inland passing under the basalt plains. The deposit, where not protected by the lava flow has suffered much from denudation, and its material has frequently been redistributed. This great denudation had already progressed far before the outpouring of the Newer Volcanic Rocks, and in some places, as at Northcote Hill, we find an inlier which rises high above the lava plain.

The ferruginous beds, according to Selwyn (1), underlie the lowland between Melbourne and Port Melbourne. The bores to

which Selwyn refers were probably put down in connection with the scheme for a canal from Melbourne to the bay and may be the same as the series alluded to by Mr. Henry Ginn (20). Another series, "through the foot of Emerald Hill" by Mr. James Blackburn (20), seems to have proved nothing but the absence of "rock." The Coode Canal does not, as shown by Mr. A. H. S. Lucas, cut through anything but the post-tertiary series (21). There is no evidence to show whether these ferruginous beds under the area in question are Eocene or Miocene, though from the depth at which they were struck, Eocene seems more probable. The same uncertainty prevails about the yellow sands and clays in the upper part of the Altona Bay and Newport shafts.

Taken as a whole, it seems that the Miocene sediments grow finer as we approach the present coast-line. Conglomerates are commoner inland where they cap many of the hills and extend over wide areas. About Brunswick the sections exposed in the brick pits show in places a fairly heavy conglomerate of quartz pebbles. On the Brighton coast the beds are finer in texture and no coarse conglomerates have come under our notice, while the presence of fossil-wood still points to the proximity of land. No marine fossils have been recorded at any great distance from the present coast-line and it seems probable the marine series does not extend far inland, but gives place to a series of terrestrial and freshwater beds.

The thickness of the Marine Miocene does not seem to have been very great. The section exposed in the Beaumaris cliffs does not exceed a hundred feet in thickness and may be taken as indicating approximately the thickness of the series.

The dip of the Miocene beds is very inconstant and is as a rule slight, $5^\circ - 10^\circ$ being the usual amount, while in one instance, at Beaumaris, the dip is over 20° though only persisting for a short distance. The general strike is about north-west but is somewhat variable. The deeper beds of the series being more ferruginous than the upper ones are more weather-resisting and when brought to the surface on the shore-line form the points which project into the bay. Every little point has either a mass of the ferruginous beds *in situ* for its base or by its beds of shingle shows their near proximity.

The Newer Volcanic Rock.

This is mapped as "Upper Newer Volcanic" and is younger than miocene. Its junction with the underlying ferruginous sands and gravels of probably Miocene age may be seen clearly in a quarry behind the old Flemington Meat Preserving Works on the Saltwater River at Maribyrnong, and in several other escarpments along the Saltwater from here up.

Post Tertiary.

Near the Williamstown Racecourse is a large area covered with marine beds, reaching about 20ft. above sea-level. Mollusca are abundant and seem, as far as we have examined them, to be all living species. The fossiliferous beds of the Yarra Estuary, and the Elwood Swamp, the silt beds of Albert Park, marking an old course of the Yarra towards St. Kilda, and the shell-bearing beds of the Carrum Swamp may be referred to the same epoch.

Capping the Miocene from Elsternwick to Mordialloc recent shells are to be found in places. These have frequently been referred to as indicating a recent subsidence and subsequent upheaval. As far as our observations go the shells are confined to the present coast line, and Mr. T. S. Hart tells us that he is of the same opinion. Their present position is due we think to two causes: the lighter shells have been blown up the slopes by the wind, while the heavier ones may have been carried there by the natives. At Picnic Point, on its northern side, these shells can be traced from sea-level, where the deposit is daily being added to, up the slope to a height considerably above the level of even a "storm beach." If a cliff were cut back here now we should have a similar state of affairs to that which we find commonly along the coast.

Origin of the Sediments.

Silurian rocks have probably yielded the greater part of the Tertiary sediments. In places, however, the sand grains are large and roughened so that the presence of granite in the neighbourhood is probable. Such sands occur south-east of Black Rock. The quarter-sheet states that the Tertiary rocks, near the Toorak Railway Station, rest on "decomposed granite." The

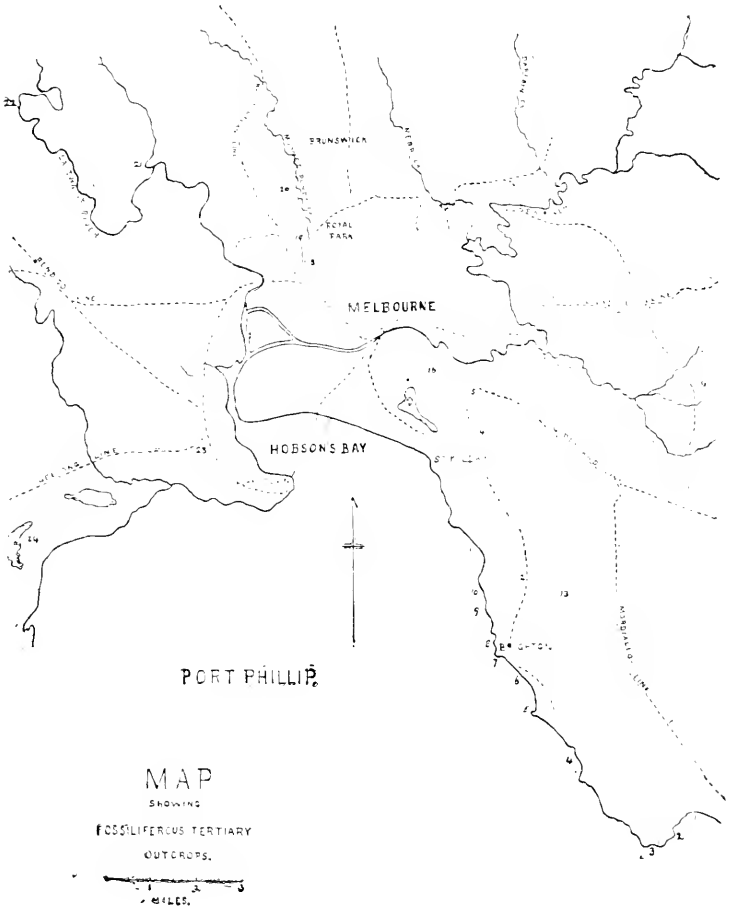
bed rock is not now visible about here, so that we cannot discuss this statement. The new edition of the Catalogue of Rocks in the Technological Museum describes a specimen (Nr. I., 79) as "decomposed granite" from the foundations of the Royal Hotel, St. Kilda. The specimen in the Museum is evidently a granitoid rock, but we have not had an opportunity of closely inspecting it.

The sewerage tunnel under Stoney Creek, north of the pumping station, passed through a granitic sand composed of roughened quartz grains, white clay and flakes of black mica. Mr. Spry has shown us similar material from a sewerage shaft near the South Yarra Railway Station. The large sand grains in the clays under the Older Volcanic at North Melbourne seem to suggest a similar granitic origin.*

In conclusion we have to thank numerous friends for information, and for the opportunity of examining fossils from various localities. Mr. T. S. Hart's knowledge of the Brighton district has been of great help. Mr. A. W. Craig has allowed us to carefully examine his large collections from the Eocene of Royal Park. We have also received fossils from various localities from Rev. G. Ramage, Messrs. J. A. Atkinson, A. E. Kitson, J. T. Jutson, E. J. Robertson, Graham Officer, and others, while Messrs. G. D. Barker and Hosie have kindly supplied us with particulars in reference to several bores. Mr. T. W. Fowler has been good enough to survey the cutting in Royal Park for us and to give us the contour of the cutting.

* Since the paper was read Mr. J. A. Atkinson has drawn our attention to the presence of a decomposed coarse granitoid rock in a sewerage shaft at Kensington Road, Toorak. Some hundreds of loads were obtained.

In the Map the figures refer to the fossiliferous localities as numbered in the body of the paper.



EXPLANATION OF PLATE VIII.

Railway cutting in Royal Park. The measurements were made along the south-east side. North-east end to left.

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CUTTING in ROYAL PARK.

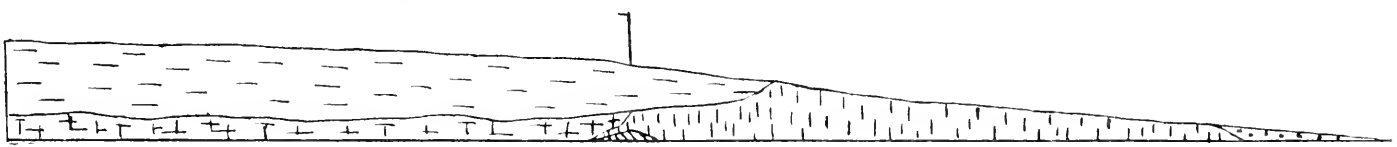
1 IN. = 1 CHAIN

Proc. R.S. Victoria 1896

Plate 8.

DATUM LINE

DATUM LINE



DATUM LINE

HILL WASH

MIOCENE

STRATIFIED EOCENE

OLDER VOLCANIC

UPPER SILURIAN

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Art. XV.—*Catalogue of Non-Calcareous Sponges collected by J. Bracebridge Wilson, Esq., M.A., in the Neighbourhood of Port Phillip Heads.*

Part III.

By Arthur Dendy, D.Sc.,

Professor of Biology in the Canterbury College, University of New Zealand; Corresponding Member of the Royal Society of Victoria.

Introductory Remarks.

The present instalment of the catalogue deals with the families *Axinellidæ*, *Suberitidæ* and *Spirastrellidæ*, together with a few specimens which, owing to the difficulty of determining their true systematic position, were accidently omitted from their proper places in the preceding parts. Altogether forty species are included in this part, of which twelve are new to science. It has been necessary to erect two new genera, *Sigmaxinella* and *Pseudoclathria*.

This brings us to the end of the Monaxonida, at least according to the acceptation of that term in the Challenger Report, but there still remain a number of genera of doubtful position, whose consideration I postpone until I shall have been able to study more fully the Tetractinellid Sponges, with which they seem to have more or less affinity. Such are the genera *Tethea*, *Chondrilla*, *Stellettinopsis*, *Trachya*, *Halisarca* and *Chondrosia*.

At this stage of the work one cannot help being struck with the exceeding richness of the monaxonid sponge-fauna of the Victorian coast. The present catalogue includes altogether 135 species and no doubt many still remain to be discovered.

Perhaps I may be allowed in this place to express my very deep regret at the death of my old friend Mr. J. Bracebridge Wilson, to whose untiring exertions the study of Spongology is so deeply indebted, and whose loss leaves a gap in the list of Australian Naturalists which we can scarcely hope to see filled.

Family AXINELLIDÆ.

Skeleton typically non-reticulate; consisting of ascending axes of fibres from which arise subsidiary fibres radiating to the surface. Fibres typically plumose. Megascleres typically stylote but ranging to oxeote. Microscleres rarely present, never chelæ.

Genus *Hymeniacidon*, Bowerbank.

Skeleton reticulate, with or without well-defined spiculo-fibre, not plumose. Megascleres styli or subtylostyli. No microscleres.

Von Lendenfeld's genus *Stylotella*, placed by himself amongst the Heterorrhaphidæ and by Topsent amongst the Esperellinæ, is clearly not distinguishable from *Hymeniacidon*, even when the latter is employed in the restricted sense of the Challenger Report.

Hymeniacidon rigida, Lendenfeld, sp.

Stylotella rigida, Lendenfeld, Catalogue of Sponges in the Australian Museum, p. 186.

I identify with this species a single specimen (R.N. 362) of digitate form, with thick, irregular branches and small vents chiefly on the sides of the branches. The skeleton is a loose reticulation of fairly stout and slender fibres, branching towards the surface, and with very wide irregular meshes between. The fibres contain a great many spicules densely packed together and invested by abundant spongin. A large number of spicules are irregularly scattered between the fibres. The dermal skeleton is very scanty, consisting of sparsely scattered spicules slightly projecting from the surface. The spicules are straight, slender styli, rather abruptly sharp-pointed and sometimes with slightly developed heads. They vary much in thickness, averaging say about 0·17 by 0·005 mm. when full-grown. Judging from the fragment sent for identification, I believe that B.M. sp. 73, left undescribed by Mr. Carter, also belongs to this species.

R.N. 362 (20 f.; "pale terra-cotta red").

B.M. sp. 73 (Reg. 86-12-15-35).

Genus *Axinella*, Schmidt.

Sponge typically ramose but may be massive. Skeleton fibre plumose. Megascleres stylote and sometimes oxeote. No microscleres.

Axinella villosa, Carter.

Axinella villosa, Carter, A.M.N.H., November, 1885, p. 361.

The only additional specimen of this species is short-stalked, bushy, with short, thick, digitiform branches, tapering rather abruptly to their apices and about half an inch thick in the middle. The surface is uniformly granular. The texture is firm and tough, with axial condensation. The skeleton is very regularly plumose, and the spicules are stout and rather short oxea, with a few stylote.

R.N. 1017 (x B).

B.M. d. 83 ("*Axinella villosa*," Reg. 86-12-15-398).

Axinella stelliderma, Carter.

Axinella stelliderma, Carter, A.M.N.H., November, 1885, p. 360.

There are three specimens in the collection which I have some hesitation in identifying with this species because, although they agree very well indeed with the fragment of the type sent to me from the British Museum, there is one feature in Mr. Carter's original description which I cannot find in any of the specimens examined by me. I refer to the long spicule "projecting from the summit of the granule and surrounded at its base sheaf-like by a number of shorter ones." In my preparations all the spicules either end naturally or are broken off short at or near the surface, and I cannot find any conspicuously differing in size from the remainder. I find that the largest spicules in the type measure about 0·68 by 0·008 mm., which agrees very well with Mr. Carter's own measurements.

The skeleton is very *Raspailia*-like; with a central axis of thick, anastomosing, laminated horny fibres, cored by the slender styli, from which loose, irregular slender whisps of similar spicules curve outwards towards the surface.

The external form varies somewhat, the branches being sometimes long and sometimes short, but always coming off more or less in one plane. Two specimens show minute vents, mostly marginal.

The name *stelliderma* is hardly well-chosen and evidently refers to a very minute character which entirely escaped my own observation, for I have noted the surface as being even but granular.

R.N. 271 (20 f.; "rich maroon-red mottled with a lighter shade"); 887 (s. 9); 889 (s. 9).

B.M. sp. 60 ("*Axinella stelliderma*, C. one of types." Reg. 86-12-15-33).

Axinella acerata, Carter.

Axinella stelliderma var. *acerata*, Carter, A.M.N.H., November, 1885, p. 360.

I identify with this species (which appears to be quite distinct from *A. stelliderma*), three specimens which agree with Mr. Carter's description fairly well, except that the colour in life was yellow or orange instead of purple, and I have been unable to recognise in my sections the stellate character of the dermis. The latter, however, I imagine to be due to the arrangement of the soft tissues and not to the spicules, and it may even be an effect of shrinkage. The slender oxeote spicules vary a good deal in size, as also does the length of the branches of which the sponge is composed. The *Raspailia*-like arrangement of the skeleton and the irregularity exhibited by the ends of the oxeote spicules are characteristically axinellid.

R.N. 355 (19 f.; "dull ochre-yellow"); 358 (19 f.; "orange"); 405 (x, 19 f.; "Indian yellow").

Axinella clathrata, n. sp.

The single specimen is erect, stipitate; composed of short, slender, subcylindrical branches extended in one plane and anastomosing in a clathrous manner. Surface glabrous and minutely conulose. Vents not visible. Colour in spirit nearly white. Texture tough and resilient.

Skeleton, consisting of a thick central axis of densely but irregularly packed spicules, occupying nearly half the entire thickness of the branch and giving off at frequent intervals thick, loose, irregular strands of spicules towards the surface, where they end in the low conuli. There is no visible spongin.

Spicules, long, slender, unequal-ended oxea; usually gently curved and sharply pointed at both ends and very finely at at least one, but sometimes becoming stylote; measuring about 0·4 by 0·006 mm.

The skeleton is very like that of a *Raspailia* but for the absence of spongin and of spined styli.

R.N. 1006 (x B).

Axinella pilifera, Carter.

Axinella pilifera, Carter, A.M.N.H., November, 1885, p. 362.

It is with some little hesitation that I identify with this species four specimens varying from massive to coral-like in external form. The surface is cactiform and glabrous, minutely reticulate between the conuli. The texture is very soft and spongy, and there is a scanty skeleton of stout horny fibre containing oxeote spicules which measure about 0·33 by 0·008 mm., and which are sometimes arranged in a typically axinellid fashion. The fibres end in the conuli. The specimens are very opaque, owing to the development of immense numbers of granular pigment cells. The colour in spirit is pale yellow.

R.N. 463 (s. 9, 20 f.; ("ochraceous-buff"); 493 (s. 10, 8 f.; "orange ochraceous"); 904 (s. 10); 1109 (x C).

B.M. sp. 62 ("*Axinella pilifera*, C. Type;" Reg. 86-12-15-135).

Axinella solida, Carter.

Axinella solida, Carter, A.M.N.H., November, 1885, p. 362.

This species has a sessile, spreading or proliferously lamellar habit, with conulose surface. The columnar structure, due to the plumose skeleton fibres, is very characteristic. The spicules are stylote, varying much in size.

R.N. 731 (x B; "wax-yellow"); 738 (x B; "orange"); 890 (s. 9); 1158.

(*B.M.* sp. 61, labelled "*Axinella solida*" and registered 86-12-15-59, contains sigmata and trichodragmata, and is evidently wrongly named; indeed, Mr. Kirkpatrick informs me that Mr. Carter suggests its being re-examined. It is a specimen of *Sigmaxinella flabellata*).

Axinella meloniformis, Carter.

Axinella meloniformis, Carter, A.M.N.H., November, 1885, p. 362.

The original type was globular, sessile, ridged like a melon, but it was very small and may well have been young. All the

three specimens now recorded are lobose and corrugated, and two of them have short stalks. The skeleton is very irregular, subreticulate, with a tendency to form slightly plumose fibres, in which the rather large spicules are held together by an abundant coating of pale spongin. Even in the type specimen a few styli occur amongst the oxea.

R.N. 337 ("dull grey-buff, with brownish-red on higher parts"); 503 (x, 20 f; "flame scarlet"); 605 (x, 20 f; "cadmium yellow").

B.M. sp. 65 ("*Axinella meloniformis*, C. Type." Reg. 86-12-15-117).

Axinella kirkii,* n. sp.

Massive, sessile, hemispherical; sides rugose; upper surface covered with numerous conspicuous, short, slender, conical processes. Vents small, scattered on the upper surface between the conuli. Surface glabrous or sub-glabrous, with beautifully reticulate dermal membrane between the conuli but no dermal skeleton. Texture compact, firm, but compressible and resilient. Colour in spirit yellowish-grey or brown.

Skeleton very loose and irregular, with very stout, slightly plumose columns of loosely packed spicules ascending and ending in the conuli, which they completely fill and from which some of the spicules project beyond the surface. In the body of the sponge numerous spicules are irregularly scattered between the columns.

Spicules very variable, rather large but slender, gently curved; oxeote, stylote or strongylote. Size very variable, up to about 1·0 by 0·009 mm.

R.N. 686; 884 (s. 9).

Genus *Phakellia*, Bowerbank.

Sponge more or less flabellate or cup-shaped. Skeleton often more or less reticulate. Megascleres styli and often oxea. No microscleres.

Phakellia flabellata, Carter.

Phakellia flabellata, Carter, A.M.N.H., November, 1885, p. 363.

* Named after my friend Mr. H. B. Kirk, the New Zealand Spongologist.

Phakellia crassa, Carter, A.M.N.H., November, 1885, p. 363.
Phakellia villosa, Carter, A.M.N.H., November, 1886, p. 379.
(Not *Phakellia flabellata*, Ridley and Dendy, Challenger Monaxonida, p. 171).

Mr. Carter's three species appear to me to be indistinguishable. The sponge is characterised by its stipitate, flabellate, often proliferous external form, with granular surface and small stellate vents. The skeleton is subreticulate but with slightly plumose main fibres curving outwards towards the surface. The spicules are short stout styli, sometimes oxeote, measuring about 0·25 by 0·01 mm. in the type of *P. crassa*, and varying somewhat in different specimens.

(By an unfortunate oversight the name *flabellata* was given in the Challenger Report on the Monaxonida to a *Phakellia* from Port Jackson which is quite distinct from Mr. Carter's species. As the latter has priority, though only by a short while, I propose to re-name the Challenger species *Phakellia jacksoniana*).

R.N. 326 (18 f.; "orange-yellow"); 679 (s. 9; "orange"); 1162 (x).

B.M. sp. 58 ("*Phakellia crassa*, C. Type," Reg. 86-12-15-129); sp. 56 ("*Phakellia villosa*, C. one of types," Reg. 86-12-15-78); d. 86 ("*Phakellia villosa*," Reg. 86-12-15-437).

Phakellia tumida, n. sp.

The single specimen is compressed, lobose, irregular; varying greatly in thickness; thinnest in the middle and with the margin more than an inch broad. Vents very small, abundantly scattered on the margin. Surface uneven, slightly warty and rugose; subglabrous; very minutely reticulate on the flattened surfaces. Compact but very compressible and resilient. Pale greenish-yellow in spirit.

The skeleton is a pretty close-meshed but extremely irregular network of branching and anastomosing fibre. The fibres are about 0·09 mm. thick, not very definite, containing a great many spicules and no obvious spongin. Towards the surface the fibres subdivide rapidly and give rise to the dermal tufts of spicules, which in surface view are seen to be arranged in a close reticulation. Large numbers of spicules are thickly scattered in the soft tissues between the fibres of the main skeleton.

The spicules are slightly curved styli or subtylostyli; gradually sharp-pointed and measuring about 0·18 by 0·006 mm.

This species appears to combine the characters of *Hymeniacidon* with those of *Phakellia* and it is with some doubt that I include it in the latter genus.

R.N. 1155 (x).

Genus *Acanthella*, Schmidt.

Axinellidæ of ramose, bushy or frondose external form; of cartilaginous consistency, and with glabrous surface beset with ridges and spines. No distinct horny fibre. The smooth linear megascleres range from stylote to oxeote in form. No microscleres.

The arrangement of the spicules in dense wide tracts with intervening spaces almost or quite devoid of spicules appears to be also very characteristic.

Acanthella stipitata, Carter.

Acanthella stipitata, Carter, A.M.N.H., May, 1881, p, 380, pl. xviii., fig. 8.

Acanthella cactiformis, Carter, A.M.N.H., February, 1885, p. 114.

Acanthella hirciniopsis, Carter, A.M.N.H., November, 1885, p. 364.

Acanthellina parviconulata, Carter, A.M.N.H., November, 1885, p. 365.

Acanthellina rugolineata, Carter, A.M.N.H., November, 1885, p. 365.

The forms here included all appear to belong to one very variable species; at any rate there are so many intermediate characters that I can find no tangible points of distinction between them.

R.N. 389; 465 (x, 20 f.; "poppy-red"); 659; 740 (x B; "orange"); 1003 (two specimens, s. 1 and x B); 1004 (x B); 1058 (x A); 1159; 1161 (x).

B.M. sp. 49 ("*Acanthella cactiformis*, C.," Reg. 86-12-15-91); sp. 50 ("*Acanthella parviconulata*, C.," Reg. 86-12-15-56); sp. 51 ("*Acanthella hirciniopsis*, C.," Reg. 86-12-15-38); sp. 52 ("*Acanthella rugolineata*, C," Reg. 86-12-15-94); d. 90 ("*Acanthella rugolineata*," Reg. 86-12-15-365).

Acanthella tenuispiculata, n. sp.

Compressed, flabellate, only about one-third of an inch thick; may be proliferous. Surfaces glabrous, closely beset with small conuli which are sometimes joined in short ridges; may be minutely porous between. Vents in one specimen not seen, in the other small but prominent, scattered on both surfaces, each on a small low eminence. Texture tough, compact, leathery, with strong skeletal condensation in the median plane. Pale yellowish pink or nearly white in spirit.

Skeleton without any visible spongin, composed of long slender spicules densely packed together in the median plane and extending obliquely outwards and upwards in thick looser parallel strands into the low conuli.

Spicules very long and slender styli (sometimes oxeote), gently curved and with irregular points, measuring about 0·64 by 0·008 mm.; with occasional very slender sinuous forms.

R.N. 542 (x, 19 f.; "orange-chrome"); 1188.

Genus *Ciocalypta*, Bowerbank.

Sponge with large subdermal cavities roofed over by the dermal membrane, which is provided with a well-developed dermal skeleton and supported on pillars of spiculo-fibre radiating outwards from the denser central portion of the main skeleton. Megascleres stylote or oxeote. No microscleres.

This genus includes Mr. Carter's *Leucophlœus*.*

Ciocalypta penicillus, Bowerbank.

Ciocalypta penicillus, Bowerbank, Mon. Brit. Spong., vol. i., pl. xxx., figs. 360, 361; vol ii., p. 81; vol iii., p. 33, pl. xiii., figs. 2, 3, 4.

Leucophlœus massalis, Carter, A.M.N.H., November, 1883, p. 323, pl. xiv., fig. 15.

? *Ciocalypta penicillus*, var. *aciculata*, Carter, A.M.N.H., November, 1885, p, 366.

Leucophlœa massalis, Carter, A.M.N.H., November, 1885, p. 366.

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* For characters of *Leucophlœus* see A.M.N.H., February, 1884, p. 130.

The sponge consists of a massive, rounded base, from which spring numerous upright, finger-like processes. The dermal membrane, with its abundant spicules, is supported over large subdermal cavities by columns of spicules radiating from a dense axial skeleton in the digitiform processes. The spicules are all, or nearly all, stylote, and of variable size, sometimes all of about the same diameter, sometimes with some of the internal spicules much stouter than the others.

Mr. Carter himself points out the close resemblance of his species to that of Bowerbank, as follows:—"The illustration of *C. penicillus* (*op. et l.c.*) closely resembles in figure that of *Leucophlœus massalis*, only the latter is more compact towards the centre, but the form of the spicule is the same, viz., *acuate*, while the two other species of *Ciocalypta* present *acerate* spicules;" etc.* In face of these remarks I am unable to understand why the genus *Leucophlœus* should have been erected, or why *Ciocalypta penicillus* and *Leucophlœus massalis* should have been both included as distinct species in the work on Mr. Bracebridge Wilson's sponges.

R.N. 379 (s. 8, 8 f.; "lemon-yellow").

B.M. sp. 55 ("*Leucophlœus massalis*, C." Reg. 86-12-15-82); d. 92 ("*Ciocalypta penicillus*" Reg. 86-12-15-457).

Ciocalypta tyleri, Bowerbank.

Ciocalypta tyleri, Bowerbank, Proc. Zool. Soc. Lond., 1873, p. 21, pl. iv., figs. 9-12.

Ciocalypta tyleri, Carter, A.M.N.H., November, 1885, p. 366.

The sponge is massive with digitiform processes, like *C. penicillus*, but with all or may of the spicules oxeote.

Specimens intermediate in spiculation between *C. penicillus* and *C. tyleri* are met with. *B.M.* sp. 54† is very remarkable in this respect and should perhaps form the type of a new species. It has a mixture of very stout and very slender *styli* in the main skeleton but only very slender *oxea* in the dermal skeleton.

R.N. 585 (s. 1, 14 f.; "ochre-yellow"); 595 (x, 19 f.; "primrose-yellow"); 810 (s. 5); 905 (s. 8); 949 (s. 9); 1089 (x A); 1133.

* A.M.N.H., November, 1883, p. 326.

† Labelled "*Ciocalypta penicillus*, Bk. P.P.H. 19 fms." Reg. 86-12-15-136.

Ciocalypta compressa, Carter, sp.

Leucophlœus compressus, Carter, A.M.N.H., November, 1883, p. 324, pl. xiv., fig. 16.

This species is at once distinguished from the preceding by its compressed, lobose, flabellate, proliferous, sometimes stipitate external form. The dermal skeleton gives to the surface a minutely reticulate appearance, and the densely spiculous dermal membrane is supported over large subdermal cavities by the expanded ends of the outwardly curving, plumose fibres of the main skeleton. The spicules are rather slender oxea, gently curved and gradually and smoothly pointed, very variable in size, up to about 0·4 by 0·0083 mm. in the specimen measured.

R.N. 272 (20 f.; "yellowish light brown"); 381 (19 f.); 449 (s. 9, 17 f.; "chrome-yellow"); 500 (s. 6, 6 f.; "ochre-yellow"); 754 (s. 5; wax-yellow"); 806 (s. 5); 917 (s. 8); 961 (s. 6).

Sigmaxinella, n. gen.

Axinellidæ with microscleres in the form of sigmata and trichodragmata.

The genus comes near to *Thrinacophora*, Ridley and Dendy, but differs in the addition of the sigmata, and as there are three well-marked species exhibiting this character in the collection, the erection of a new genus for their reception seems to be desirable. It is the only known genus of Axinellidæ in which sigmata are present and is therefore very remarkable.

Sigmaxinella australiana, n. sp.

Sponge consisting of a bushy bunch of rather slender, short, subcylindrical or somewhat compressed branches, sometimes anastomosing and supported on a short stalk. Surface granular or minutely hispid. Vents small, sometimes stellate, scattered or serial along the branches. Tough, compressible, resilient. Pale greyish-yellow in spirit.

Skeleton Raspailia-like: consisting of a thick, dense axial portion from which slender fibres curved outwards towards the surface, where they end in sparse, slightly projecting tufts of spicules. There is a strong development of pale coloured spongin, forming definite fibres rather sparsely cored by the

spicules. These horny fibres form a close reticulation in the axial portion of the sponge and to a less extent towards the periphery. The relation of the spicules to the spongin is not very definite, they are chiefly embedded in and projecting from the main fibres.

Megascleres slender, ranging from stylote to oxeote, often with irregular ends. Size very variable, up to about 0·3 by 0·006 mm.

Microscleres, (*a*) very slender, simple and contort sigmata, varying in size, up to about 0·33 mm. from bend to bend. Very abundant, in bundles (sigmadragmata) or scattered separately; (*b*) short, hair-like raphides, mostly in dense bundles (trichodragmata), about 0·025 mm. long. Very abundant.

This is one of the best characterised and altogether most satisfactory species in the collection.

R.N. 352 (19 f.; "brownish-red"); 388; 616 (x, 19 f.; "orange-rufous, lighter orange below"); 654 (x, 20 f.; "orange-rufous"); 812, 1063.

Sigmaxinella flabellata, Carter, sp.

Axinella flabellata, Carter, A.M.N.H., November, 1885, p. 361.

Sponge composed of proliferous lamellæ about a quarter of an inch thick, springing from a short, thick stalk. Surface coarsely granular or minutely conulose. Vents minute, marginal or scattered. Colour in spirit pale greyish-yellow. Texture tough, fibrous, resilient.

Skeleton, dense, composed of loose, plumose, spicular fibres, curving outwards towards the surface, beyond which the ends of the terminal spicules project slightly.

Megascleres, more or less curved styli, evenly rounded at the base and gradually and sharply pointed at the apex; commonly rather stout, up to about 0·29 by 0·0166 mm., but varying, especially in thickness.

Microscleres, (*a*) numerous, very slender, simple and contort sigmata, measuring about 0·0166 mm. from bend to bend; (*b*) trichodragmata and scattered rhaphides, up to about 0·049 mm. long.

Three of the specimens are beset with parasitic Actinozoa.

R.N. 480 (x, 20 f; "vinaceous-cinnamon"); 516 (s. 8, 9 f; "wood brown"); 681 ("sponge-brown"); 819 (s. 1); 944 (x A).

B.M. sp. 61 (wrongly labelled "*Axinella solida*." Reg. 86-12-15-59).

Sigmaxinella ciocalyptoides, n. sp.

Massive, sessile, rising above into short digitiform projections; the whole apparently formed by the incomplete fusion of numerous vertical processes enclosed below in a common dermal membrane. Surface acutely conulose, grooved vertically; with very distinct, minutely reticulate dermal membrane supported on fibrous pillars over large subdermal cavities. Vents sometimes large, in depressions of the surface. Texture somewhat cavernous but firm and resilient. Colour in spirit pale greyish-yellow.

Skeleton, composed of stout ascending columns of irregularly and rather loosely arranged spicules, from which stout plumose spicular fibres radiate outwards to the surface, where they end in small conuli from which the ends of the terminal spicules project somewhat. There is a good deal of spongin in some of the fibres but its development appears to be very irregular. Transverse sections of the vertical processes are extremely characteristic, showing the central mass of spicules occupying about a quarter of the diameter of the section, and the stout radiating fibres coming off from it at wide intervals like the spokes of a wheel and with the large subdermal cavities between their outer ends. There is no dermal skeleton.

Megascleres, ranging from stylote to oxeote, but chiefly styli; slightly curved; variable in size, up to about 0·5 by 0·018 mm. but seldom so stout.

Microscleres: (*a*) sigmata, small and slender but extremely numerous, simple and contort, about 0·0166 mm. from bend to bend; (*b*) trichodragmata, usually small bundles of short, slender rhaphides about 0·03 mm. long: often in dense agglomerations.

The specific name was suggested by a certain resemblance to the genus *Ciocalypta*, from which the present species differs, however, in the absence of dermal skeleton and the presence of microscleres.

R.N. 338 (18 f; "Projections yellow-buff, the tympanised interstices grey"); 442 (s. 9, 17 f; "cinnamon, the projections deep chrome"); 882 (s. 9); 1092 (x A).

Genus *Higginsia*, Higgin.

Axinellidæ of massive or lobose external form and irregular, confused skeleton. With oxeote or stylote megascleres and small spined oxea (microxea) for microscleres.

This genus appears to be nearly related to *Dendropsis*, Ridley and Dendy, but differs much in external form and skeleton arrangement.

Higginsia coralloides, Higgin.

Higginsia coralloides, Higgin, A.M.N.H., April, 1877, p. 291, pl. xiv., figs. 1-5.

Higginsia coralloides, Carter, A.M.N.H., November, 1885, p. 357.

Higginsia coralloides, var. *massalis*, Carter, *loc. cit.*

There are six more specimens of this remarkable sponge in the collection, and as Higgin's original type was a dried and washed out specimen, while Carter contents himself with little more than identification, it may be desirable to add a few particulars derived from well-preserved spirit specimens.

The external form varies from massive and irregular to stipitate and thickly flabellate with marginal vents. The surface is rugose or conulose, with reticulate dermal membrane stretched between the projections. Texture pretty compact but resilient and yielding. Colour in spirit nearly white.

The skeleton is very confused and irregular, without any definite fibre, composed of densely intermingled oxeote spicules, especially aggregated in wide tracts which trend towards the surface and end in the conuli. The presence of these ill-defined tracts of spicules, with intervening spaces almost free from megascleres, gives a somewhat columnar character to vertical sections. Internally all the tracts unite in one dense, irregular agglomeration of spicules.

The megascleres are, as pointed out by Higgin, of two kinds, stout oxea and slender oxea, the latter being chiefly aggregated in loose dermal tufts or brushes. The microscleres are slender, slightly curved, often angulated, spined oxea.

Having received from Mr. Carter a boiled out preparation of spicules from a Grenada specimen, doubtless Higgin's original type, I have been able to satisfy myself of the correctness of the

identification. The curvature of the ends of the stout oxeote spicule shown in Higgin's drawing appears to be immensely exaggerated, as a rule it is not noticeable.

R.N. 517 (s. 8, 9 f.; "hair-brown"); 643 (s. 8, 8 f.; "ecru-drab and about the edge maroon-purple, subdued with a wash of brown"); 891 (s. 9); 927 (s. 1); 1101 (x C); 1140 (x).

Higginsia lunata, Carter.

Higginsia lunata, Carter, A.M.N.H., November, 1885, p. 358.

There are three specimens of this sponge in the collection. They are all massive, sessile, rising above into short digitiform processes which sometimes bear vents at their summits. The surface is conulose, with subglabrous, minutely reticulate dermal membrane between the conuli. The texture is compact but soft and spongy.

The skeleton is feebly developed, sparse and irregular, consisting of very loose bands of spicules trending towards the surface. The megascleres are very long but fairly stout styli and oxea, commonly with irregular ends. There are also numerous very long, slender hair-like spicules which may be young forms of the last or possibly rhaphides. The microscleres are minute fusiform oxea, usually strongly curved, crescent-like; Carter describes them as microspined, but I can only find the faintest trace of roughening. All the specimens which I have seen are densely charged with pigment granules, which render the sections somewhat opaque.

R.N. 374 (18 f.; "Slate-brown with greenish tinge"); 589 (x, 19 f.; "clove-brown, at base sepia"); 680 (s. 5).

B.M. sp. 68 ("*Higginsia lunata*, C." Reg. 86-12-15-138).

Genus *Trachycladus*, Carter.

Axinellidæ with oxeote to stylote megascleres and minute spiral microscleres.

This genus probably includes Lendenfeld's *Spirophorella*,* as Topsent has already indicated, though the type species of that genus, *S. digitata*, from Port Jackson, appears from the description to be quite distinct from the common southern species *Trachycladus laevispirulifer*.

* Catalogue of Sponges in the Australian Museum, p. 236.

Trachycladus lævispirulifer, Carter.

Trachycladus lævispirulifer, Carter, A.M.N.H., May, 1879, p. 343, pl. xxviii., figs. 1-5, and November, 1885, p. 357.

This species forms a very characteristic element of the sponge fauna of Southern Australia and may be very readily recognised by its irregularly branched external form with usually long and slender branches, by its brilliant red or orange colour in life, disappearing in spirit, and by its abundant minute spiral microscleres. Scarcely less characteristic of the species is the presence of immense numbers of short, jointed algal rods, in which, according to Mr. Carter, the red colour is lodged and which give to sections of the sponge a very peculiar opaque appearance.

Some of my specimens exhibit faint microspination of the spiral microscleres. This is especially seen in *R.N.* 415 and 1046, which are also of more robust and shorter branched habit than usual. It must be remembered, however, that the original type figured by Carter was also short-branched.

R.N. 297 (20 f.; "orange-red"); 306 (20 f.; "orange-scarlet"); 366 (20 f.; "crimson"); 415 (x, 19 f.); 426 (x, 19 f.; "flame-scarlet"); 467 (x, 20 f.; "orange-chrome"); 470 (x, 20 f.; "scarlet"); 983 (s. 1); 984 (s. 1); 1000 (s. 1); 1035 (x B); 1046 (x B); 1061 (x A).

B.M. sp. 71 ("*Trachycladus lævispirulifer* C," Reg. 86-12-15-42); d. 126 ("*Trachycladus lævispirulifer*," Reg. 86-12-15-421).

Family SUBERITIDÆ.

Megascleres typically tylostylote, sometimes stylote. No microscleres. Sponge usually massive. Spongin usually absent. Usually with a dermal crust of radially arranged spicules.

Genus *Suberites*, Nardo.

Sponge usually irregular in form, massive to ramose, without mammiform projections and without marginal fringe of spicules. Usually with well-developed heads to the tylostyli.

Suberites carnosus, Johnston sp.

Halichondria carnosa, Johnston, British Sponges, p. 146, pl. xiii., figs. 7, 8.

Hymeniacidon carnosa, Bowerbank, Mon. Brit. Spong., vol. ii., p. 203, vol. iii., pl. xxxvi., figs. 5-9.

Suberites carnosus, Ridley, Zool. Coll. H.M.S. "Alert," p. 465.

Suberites globosa, Carter, A.M.N.H., February 1886, p. 116.

Suberites (*Hymeniacidon*) *carnosus*, Carter, A.M.N.H., December, 1886, p. 456.

Suberites carnosus, Ridley and Dendy, Challenger Monaxonida, p. 197.

This species is easily recognised by its globular to fig-shaped external form, compact structure and long, slender, pin-headed spicules (tylostyli) arranged confusedly in the interior and in radiating brushes at the surface. The spicules in my specimens measure about 0·29 by 0·004 mm., which is rather smaller than Bowerbank gives for the British form. My Victorian specimens are also characterised by conspicuous, usually large vents, while in the British form the vents are inconspicuous, but this difference can scarcely be specific.

R.N. 294 (20 f.; "brownish-yellow"); 427 (x, 19 f.; "Cinnamon"); 1010 (x B); 1034 (x B); 1090 (x A).

B.M. sp. 15 ("*Suberites globosa*, Carter?" Reg. 86-12-15-106); d. 119 ("*Suberites carnosa*," Reg. 86-12-15-386).

Suberites flabellatus, Carter.

Suberites flabellatus, Carter, A.M.N.H., February, 1886, p. 117.

? *Suberites globosa* (elongated form), Carter, A.M.N.H., February, 1886, p. 116.

This species is very common in Port Phillip and may be easily recognised by its compressed, lobose, digitate or branching form, its orange or yellow colour in life, fading in spirit, and its typical pin-headed spicules considerably larger than those of *S. carnosus*.

R.N. 296 (20 f.; "wax-yellow"); 378 (18 f.; "dark orange"); 488 (s. 10, 8 f.; "orange-ochraceous"); 623 (x, 19 f.; "orange"); 799 (s. 10); 809 (s. 5); 893 (s. 10); 988 (s. 9); 1012 (x B).

B.M. d. 115 ("*Suberites flabellata*," Reg. 86-12-15-384); d. 116 ("*Suberites globosa* (branching form)," Reg. 86-12-15-378).

Suberites insignis, Carter.

Suberites insignis, Carter, A.M.N.H., February, 1886, p. 118.

This species is distinguished by its massive form, with wide

canals internally, and its dark grey colour in life and in spirit. My specimen is only a piece, so that I cannot confirm Carter's observations on the remarkable canal system.

R.N. 705 (s. 5; "dark slate, turns green in spirit").

B.M. sp. 14 ("*Suberites insignis* C. Type;" Reg. 86-12-15-125).

Suberites wilsoni, Carter.

Suberites wilsoni, Carter, A.M.N.H., February, 1885, p. 113.

This species is quite unmistakable on account of its brilliant carmine or purple colour, which is not lost either in spirit or in drying, and which has a remarkable power of staining other objects when it is bruised in sea-water. It grows to a large size and is massively lobose, with large vents arranged along the prominent ridges, and it usually contains a great deal of coarse sand.

R.N. 331 (18 f.; "rich aster-purple"); 524 (x, 20 f.; "aster purple").

B.M. sp. 13 ("*Suberites wilsoni*, C."; Reg. 86-12-15-107); d. 113 ("*Suberites wilsoni*"; Reg. 86-12-15-253).

Suberites spirastrelloides, n. sp.

? *Suberites wilsoni*, var. *albidus*, Carter, A.M.N.H., February, 1886, p. 116.

The single specimen is massively lobose, compressed to a narrow ridge at the top. Surface warty below, slightly rugose longitudinally above. Vents rather large, in close-set single series on the ridge-like margin. Wide oscular tubes lead up to the vents, running parallel up each flattened side just beneath the surface in a very characteristic manner. Texture compact but somewhat cavernous; scarcely compressible, with much coarse sand internally. Colour internally, in spirit, sandy-yellow. (The surface is now dark purple, but that this is due to artificial staining, probably by some other sponge, is proved by the fact that two of the cut surfaces have the same colour, and the colour does not penetrate beyond the surface).

Skeleton, extremely confused, composed of slender spicules, for the most part abundantly and irregularly scattered, but with a slight tendency to collect together in loose fibres which may then

form an irregular reticulation. The dermal skeleton is rather lax for a *Suberites*, composed of radiating tufts of similar spicules, frequently interrupted by a delicate pore-bearing membrane.

Spicules, long, slender, styli or subtylostyli, straight or slightly curved; with feebly developed and irregular heads or none at all; usually fairly sharply pointed at the apex. Size tolerably uniform throughout, say about 0·37 by 0·006 mm., with no marked distinction between the dermal and deep spicules.

I have little doubt that this species is identical with Mr. Carter's *S. wilsoni*, var. *alöidus*, though in the absence both of proper description and specimen of the latter it is impossible to be certain, and it seems safest to give it a distinct specific name. The absence of the very remarkable and characteristic colour of *S. wilsoni* appears to be sufficient reason for specific distinction in this case.

R.N. 1128 (x).

Suberites difficilis, n. sp.

Sponge massive, rounded, lobulated, compressed. Vents? Surface granular to subglabrous. Texture compact, corky, scarcely compressible. Colour in spirit pale yellow (accidentally stained pinkish on the outside).

Skeleton, internally composed of loose, irregular bands of rather large spicules forming a very irregular network, the meshes of which are filled with numerous much smaller spicules thickly scattered through the soft tissues. Dermal skeleton composed of dense brushes of the smaller spicules arranged radially at the surface in the usual manner.

Spicules, of two very distinct sizes, though of course with intermediate forms; (*a*) relatively large, long and slender, straight or nearly so, fusiform, tapering gradually to each end, sharply pointed, without heads or with slightly developed annular swellings at some little distance from the evenly rounded base, size variable, averaging say about 0·9 by 0·01 mm., but difficult to measure, as owing to their great length they are generally broken in the section. (*b*) Of the same form as the above but very much smaller, averaging say about 0·12 by 0·014 mm.

This is an extremely difficult species to characterise, and may perhaps be best recognised by the subreticulate character of the main skeleton, and the two very different sizes of spicules of which it is composed, together with the feebly developed heads to the spicules, which are often simply stylote.

R.N. 1129 (x); ? 394.

[*Suberites parasiticus*, Carter].

Suberites parasitica, Carter, A.M.N.H., February, 1886, p. 119.

Our knowledge of this species is altogether too insufficient to justify its maintenance, the type being merely "a thin layer of small pin-like spicules about 40 by 1-6000th inch, together with others of ? *Halichondria panicea* about twice the length, parasitically covering a fucus." It is very possibly merely a young form of some common species.

B.M. sp. 11 ("*Suberites parasitica*, C. Type;" Reg. 86-12-15-110).

Genus *Polymastia*, Bowerbank.

Sponge massive, sessile, with more or less well-developed mammiform processes arising from the upper surface. Without marginal fringe of spicules. Spicules often collected in strands; often simply stylote.

Polymastia ? bicolor, Carter.

Polymastia bicolor, Carter, A.M.N.H., February, 1886, p. 119.

Polymastia bicolor, var. *glomerata*, Carter, A.M.N.H., February, 1886, p. 119.

This species is by no means a satisfactory one. It appears to be intermediate in structure between the genera *Suberites* and *Polymastia*, the well-developed mastoid processes of the latter being represented by mere warts or tubercles not sharply distinguished from the body, such as one finds in some species of *Spirastrella*. The strands of very long and stout spicules which run up into the processes of a typical *Polymastia* are also wanting, the larger spicules referred to by Mr. Carter by no means coming up to the usual standard.

R.N. 289 (18 f; "slate-brown with a yellowish-brown tinge in parts"); 538 (x, 19 f.; "gallstone-yellow"); 878 (s. 9); ? 286 (18 f; "dull lemon-yellow").

B.M. sp. 17 ("*Polymastia bicolor* Type," Reg. 86-12-15-97); sp. 19 ("*Polymastia bicolor*, C. var. *glomerata*," Reg. 86-12-15-114).

Polymastia ? massalis, Carter.

Polymastia massalis, Carter, A.M.N.H., February, 1886, p. 121.

This species appears to resemble *P. bicolor* in external form and to differ from it chiefly in the smaller size of the principal spicules. It is probably a mere variety.

B.M. sp. 20 ("*Polymastia massalis*, C.," Reg. 86-12-15-53).

Polymastia crassa, Carter.

Polymastia bicolor, var. *crassa*, Carter, A.M.N.H., February, 1886, p. 120.

There are numerous specimens in the collection of a typical *Polymastia*, with well-developed mastoid processes containing the usual longitudinal bundles of very large and stout spicules, besides the smaller spicules. These specimens appear to agree sufficiently closely with Carter's *Polymastia bicolor*, var. *crassa* to justify an identification. The species must, however, be separated from *P. bicolor*, though whether it is distinct from previously described species of *Polymastia* may be considered doubtful.

R.M. 273 (20 f.; "sand-brown, projections dull yellow"); 440 (s. 9, 21 f.; "pinkish-buff"); 1098 (x C); 1135 (x); 1146 (x); 1169.

B.M. sp. 18 ("*Polymastia bicolor*, C. var. *crassa*," Reg. 86-12-15-39); d. 114 ("*Polymastia bicolor*, var. *crassa*," Reg. 87-7-11-29); ? d. 32 ("*Polymastia bicolor*," Reg. 86-12-15-354).

Genus *Cliona*, Grant.

Suberitidæ of boring habit, excavating narrow passages in shells, etc.

It appears certain that the sponge sometimes outgrows the shell which it attacks and then assumes a massive form (*e.g. Raphyrus griffithsii*).

Cliona celata, Grant.

Cliona celata, Grant, Edinburgh New Philosophical Journal, I., 78: II., 183, pl. 2, fig. 7.

Halichondria ? celata, Johnston, British Sponges, p. 125.

Hymeniacidon celata, Bowerbank, British Spongiadæ, vol. ii., p. 212, vol iii., plate. xxxviii., figs. 5, 6.

Cliona celata, Carter, A.M.N.H., December, 1886, p. 458.

I give only some of the more important references to the literature of this common species. As regards the identification of the Australian with the European form I rely upon Mr. Carter's great experience. There happens to be only one specimen in the present collection, perforating and inhabiting a dead oyster shell, but I do not think the species is by any means uncommon in Port Phillip. The sponge may be readily recognised by its perforating habit and only pin-head spicules.

R.N. 452 (s. 9, 17 f.; "gallstone-yellow").

B.M. sp. 16 ("*Cliona celata*, Grant?" [Westernport]: Reg. 86-12-15-135).

Family SPIRASTRELLIDÆ.

Main skeleton confused or reticulate. Megascleres usually tylostylote or stylote, occasionally becoming oxeote. Microscleres some form of aster, often forming a dermal crust.

Genus *Spirastrella*, Schmidt.

Microscleres typically spined spirulæ (spirasters) ranging to double asters and irregular spherasters and spined microxea.

This interesting genus appears to have its head-quarters in Australian waters and is represented in the collection by some very remarkable and beautiful species.

Spirastrella spinispirulifer, Carter, sp.

Suberites spinispirulifer, Carter, A.M.N.H., May, 1879, p. 345, pl. xxviii., figs. 6, 7.

Suberites spinispirulifer, Carter, A.M.N.H., December, 1886, p. 456.

This beautiful species may be easily recognised by its minute spiral microsclere, resembling that of *Trachycladus*, but spined. The external form is massive, solid; the surface subglabrous but may be warty; the texture fairly compact and the colour in spirit pale greyish-yellow.

R.N. 622 (x, 19 f: "orange-ochraceous").

B.M. sp. 10 ("*Suberites spinispirulifera*, C.," Reg. 86-12-15-112).

Spirastrella papillosa, Ridley and Dendy.

? *Spirastrella cunctatrix*, Carter, *pars*, A.M.N.H., February, 1886, p. 114.

Spirastrella cunctatrix, var. *porcata*, Carter, A.M.N.H., February, 1886, p. 115.

Spirastrella papillosa, Ridley and Dendy, A.M.N.H., December, 1886, p. 491.

Spirastrella papillosa, Ridley and Dendy, Challenger Monaxonida, p. 232, pl. xli., fig. 5; pl. xlv., figs. 11-11*g*.

Sponge massively lobose, compressed or subcylindrical, usually with more or less warty but otherwise smooth and subglabrous surface. Vents variable in size, may be large, grouped on prominent parts. Texture firm, compact, corky, but penetrated by many large oscular tubes. Colour in spirit usually dark grey throughout. The surface is sometimes much infested by a parasitic Actinozoon.

Skeleton, in the deeper parts dense and confused, composed of abundant interlacing spicules, sometimes subfibrous and subreticulate. Dermal skeleton of abundant similar but smaller spicules, radially disposed, sometimes in pretty distinct brushes.

Megascleres, in the main skeleton rather long and slender, straight or slightly curved, with inconspicuous or fairly distinct, ovoid or rounded heads, with blunt or sharp apex; averaging about 0·46 by 0·0083 mm. In the dermal skeleton similar, though perhaps with proportionally larger heads, but of much smaller size, averaging say 0·2 by 0·004 mm.

Microscleres, spirasters of ordinary form, but as usual very variable. Mostly rather long and slender, with three or four slight bends, abundantly spinose, say about 0·05 by 0·012 mm., including the spines; varying to subglobostellate, up to 0·03 mm. in diameter. Scattered throughout, but most abundant at the surface.

The skeleton arrangement and spiculation agree well with the specimen of *Spirastrella cunctatrix*, var. *porcata*, in the British Museum. To judge from *B.M.* d. 120, Mr. Carter has given the length of the megascleres in his "*Spirastrella cunctatrix*" nearly twice what it should be. In spite of a little difference in the size of the megascleres, I think there can be no doubt of the

Victorian specimens being specifically identical with *Spirastrella papillosa*, obtained by the Challenger in Port Jackson.*

R.N. 674 (s. 10); 896 (s. 10); 934 (x A); 1051 (x B). The following also probably belong here, but they are mostly mere pieces and do not show the vents; 300 (18 f.; "dark slate"); 421 (x, 19 f.; "olive"); 486 (s. 10, 8 f.; "olive-grey"); 537 (x, 19 f.; "gallstone-yellow"); 620 (x, 19 f.; "slate-grey"); 1156 (x).

B.M. ? d. 120 ("*Spirastrella cunctatrix*" [south coast of Australia], Reg. 86-12-15-250); d. 125 ("*Spirastrella cunctatrix*, var. *porcata*," Reg. 86-12-15-351).

Spirastrella papillosa, var. *porosa*, nov.

? *Spirastrella cunctatrix*, Carter, *pars*, A.M.N.H., February, 1886, p. 113.

This variety is distinguished from the preceding by the sieve-like oscular areas replacing the distinct separate vents. The colour also appears to be lighter than is usual in the typical form and rather brown or yellow than dark grey. I can detect no difference in skeleton arrangement or spiculation. The best specimen is the upper part of a large, erect, compressed, thickly lobose sponge. The general surface is beset with large irregular conuli, wide apart and with a beautiful pore-bearing membrane stretched between; (these strongly developed porous inhalant areas may also be a varietal distinction). The upper margin is truncated, giving rise to a broad, slightly depressed area, perforated by innumerable small pores, beneath which the great vertical oscular tubes terminate. The colour in spirit is grey.

R.N. 290 (18 f.; "wax-yellow"); 301 (18 f.; "snuff-brown"); 562 (x, 20 f.; "raw umber").

B.M. ? d. 120 ("*Spirastrella cunctatrix*," Reg. 86-12-15-250).

Spirastrella robusta, Carter, sp.

Spirastrella cunctatrix, var. *robusta*, Carter, A.M.N.H., February, 1886, p. 114.

This sponge is lobose, compressed, thick, with smooth and even surface and small marginal vents. The texture is firm, compact and leathery, and the colour in spirit pale yellow. The megas-

* In the Challenger Report the length of the spiraster is accidentally given as 0·5 instead of 0·05 mm.

cleres are tylostyli, measuring about 0·44 by 0·01 mm. and the microscleres very robust spirasters of the ordinary form, by no means confined to the surface of the sponge but densely crowded throughout, intermingled with slenderer and probably young forms of the same. The spirasters measure about 0·044 by 0·033 mm. (including the spines) when fully grown. This species is certainly nearly related to Schmidt's *S. cunctatrix*.

R.N. 432 (x, 19 f.; "cadmium-orange"); 592 (x, 19 f.; "poppy-red, shading to buff below"); 1078 (x A).

B.M. d. 121 ("*Spristrella cunctatrix* var. *robusta*." Reg. 86-12-15-353).

Spirastrella fibrosa, n. sp.

Sponge sessile, massively lobose or irregularly rounded, or tongue-shaped with narrow margin. Surface subglabrous, minutely reticulate in parts, almost smooth or faintly conulose, nodular or warty. Vents usually small but prominent, grouped on upper parts, sometimes on small, conical, thin-walled projections. There may be a distinct cortex, but this appears to depend upon the state of growth. Texture firm, compact (but with large exhalant canals), corky, resilient. Colour in spirit pale yellow or white.

Skeleton. The main skeleton is an irregular and very wide-meshed reticulation of stout, dense, compact spicular fibre. The main lines of this fibre are about 0·36 mm. thick, and are but sparingly interconnected by secondary lines in the deeper parts of the sponge. As it approaches the surface, however, each main fibre gives gives off numerous slender branches at different levels and these subdivide again and again until they end in brushes of radiating spicules whose apices, intermingled with abundant asters, sometimes from a definite dermal reticulation, and sometimes merely a rather scanty armature of slightly projecting points. There is no visible spongin and, although the megascleres are mostly collected in the stout multispicular fibres of the main skeleton, yet many of them are irregularly scattered in the intervening ground-tissue.

Megascleres. Straight, slender styli, evenly rounded or very slightly inflated at the base and gradually and sharply pointed at the apex; of very uniform shape and size, measuring about 0·33 by 0·007 mm.

Microscleres. Very beautiful double asters with the abundantly spiny ends separated by a well-developed, smooth, cylindrical shaft. The ends vary from subglobostellate to *Latrunculia*-like, with two whorls of spines, the terminal whorl being smaller, a condition especially distinct in the smaller and slenderer forms. The larger forms measure about 0·05 mm. in total length, the smooth shaft about one-third of the total length and 0·0083 mm. in diameter, and the heads about 0·029 mm. in transverse diameter including the spines. The smaller forms vary a good deal in their proportions but are relatively slenderer and with longer shafts. The microscleres are abundantly scattered both in the deeper parts of the sponge and in the dermal membrane, but they do not form a continuous dermal crust.

This very beautiful and well-marked species appears to be most nearly related to Carter's *Latrunculia* (*Spirastrella*) *corticata*, said to come from the Red Sea, both in the arrangement of the skeleton and in the form of the microscleres, but in the latter the megascleres are oxeote. It is at once distinguished from Schmidt's *Suberites bistellatus* by the absence of distinct heads to the megascleres, and the well-developed, smooth shaft of the microscleres, which form an interesting transition to the unequal-ended discasters of *Latrunculia*.

R.N. 319 (18 f.; "orange-yellow"); 475 (x, 20 f.; "heliotrope-purple, fading into a whitish tint below"); 642 (x, 20 f.; "orpiment-orange, shading to buff below"); 1171; 1179.

Spirastrella areolata, n. sp.

Sponge sessile, massively lobose, with rounded margin, upon which numerous small vents are scattered. The largest specimen has been dried and now measures about 7½ inches high, 8 inches long, and 4½ inches thick; it thus forms a large mass but it appears to be only half of a divided specimen. Surface in spirit subglabrous but more or less areolated or at least warty. In the dry specimen the areolation is extremely distinct, especially where the cortex is least contracted, the surface being marked out in very distinct polygonal areolæ about a quarter of an inch in diameter, separated from one another by fine but sharp raised boundaries, and each area with a slightly roughened raised centre. On the rounded margin of the sponge many of the vents may be

seen to occupy each the centre of such an areola. Where the surface is much contracted the polygonal outlines between the areolæ became much less distinct, and the surface may even appear simply warty. The inhalant pores appear to be located in the slight elevations which occupy the centres of the areolæ over the general surface; the vents occupy the apices of similar though more pronounced elevations on the margin of the sponge, a condition which reminds one somewhat of the arrangement in some species of *Latrunculia*.

There is a dense cortex 1 mm. thick or more. The texture in spirit is very compact and corky, but slightly compressible and resilient, and with large exhalant canals. A little very stout, anastomosing fibre may be visible to the naked eye in the interior. Colour in spirit pale dull yellow throughout. The dry specimen is very hard, tough and incompressible, and of a pale "sponge brown" colour.

Skeleton. The main skeleton is a very sparse and irregular network of very stout, ill-defined fibres or tracts of densely agglomerated megascleres. The very wide spaces intervening between these tracts are rather sparingly occupied by loosely and irregularly scattered megascleres. The cortical skeleton is very dense, the deeper part consists of megascleres lying confusedly in every position, in the more superficial part the megascleres are arranged more or less at right angles to the surface. Sometimes the lines of demarcation between the adjacent areolæ appear to be continued right through the cortex, as shown in vertical section by the peculiar arrangement of the megascleres, which diverge from the dividing plane like hair at the parting.

Megascleres; slender, slightly curved tylostyli, with well-developed heads inflated at a short distance from the base as in many species of *Suberites;* apex varying from bluntly rounded to sharp-pointed; size about 0·4 by 0·006 mm.; perhaps a trifle shorter in the outer part of the cortex, while in the deeper parts numerous long slender hair-like forms, with relatively large heads, occur amongst the ordinary ones, of which they are probably simply young individuals.

Microscleres; of two chief forms, both doubtless modifications of the spiraster; (*a*) short, straight, rod-like, thickly covered with small spines and blunt at the extremities; size about 0·015

by 0·003 mm. including the spines; (*b*) longer and slenderer spined microxea, slightly curved or even angulate, measuring about 0·06 by 0·003 mm. These spicules remind one forcibly of those of *Higginsia*. The microscleres are abundantly scattered both in the deeper tissues and in the dermal membrane, but they are so small that they form no conspicuous part of the skeleton. The short rod-like forms are the most plentiful.

R.N. 479 (x, 20 f.; "orange-chrome"); 1187; also dried specimen.

Genus *Pronax*, Gray.*

Sponge of boring habit; megascleres tylostylote, microscleres asters (spirasters).

Pronax carteri, n. sp.

Vioa johnstonii, Carter, A.M.N.H., December, 1886, p. 458.

The sponge described by Carter is certainly quite distinct from Schmidt's *Vioa johnstonii*, having tylostylote in place of oxeote megascleres, in virtue of which it falls under Gray's genus *Pronax*. As I have seen no specimen I must content myself with referring to Carter's original description.

ADDENDA.

The following have, owing to the difficulty of determining their true position, been accidentally omitted from their proper places in the first two instalments of this catalogue.

Genus *Rhaphisia*.

(Continued from Part I., p. 257).

Rhaphisia pallida, n. sp.

Sponge massive, sessile, irregular. Surface uneven; rugose, warty or conulose, but subglabrous. Vents inconspicuous, scattered on prominent parts. Texture compact but compressible and resilient, soft. Colour in spirit pale greyish-yellow or white. In life, usually at any rate, pale grey.

Skeleton very lax and rather scanty; consisting of slender megascleres loosely scattered, or in loose whisps which run

* Proc. Zool. Soc. Lond., 1867, p. 526.

mainly towards the surface and end in the conuli. Very loosely and irregularly reticulate in parts. No dermal skeleton.

Megascleres; long and slender, usually more or less curved, with variable ends; strongylote, oxeote or stylote. Size very variable, commonly about 0·45 by 0·0055 mm.

Microscleres; numerous long, hair-like rhaphides; scattered and in loose bundles of very variable length; sometimes about 0·2 mm. long, but often more or less.

R.N. 314 (18 f.; "very light grey-buff"); 621 (x, 19 f.; "smoke-grey"); 737 (x B; "pale grey-slate"); 879 (s. 9); 982 (s. 1). ? 527 (x, 20 f; "buff-pink"); ? 1015 (x B).

Genus *Stylotrichophora.*

Stylotrichophora rubra, Dendy.

(Continued from Part I., p. 260).

The following also belong to this species:

R.N. 510 (x, 20 f.; "coral-red"); 561 (x, 20 f.; "poppy-red"); 1043.

Genus *Pseudoclathria*, n. gen.

Skeleton reticulate, the fibres composed of smooth styli cemented together by spongin; with immense numbers of short spined styli scattered through the soft tissues and forming a dermal crust, but none truly echinating the fibre although often lying alongside it. No microscleres.

This genus is proposed for the reception of Carter's *Halichondria compressa*, regarded by its describer as "*incertæ sedis.*" I was at first misled by the remarkable small, curved spined styli, and their irregularly scattered arrangement into supposing that the species might be nearly related to *Higginsia*, and therefore omitted it from the *Ectyoninæ*, amongst which I have now little doubt that it should take its place as an aberrant form, intermediate in some respects between *Clathria* and *Plumohalichondria.*

The species might, according to definition, be included in Topsent's genus *Vvesia*,* but that appears to me to be a somewhat heterogeneous assemblage which will certainly have to be recon-

* Campagnes scientifiques du Prince de Monaco. Fascicule II., p. 102.

sidered. Meanwhile as *Yvesia* is said to have normally diactinal smooth megascleres (though Topsent mentions two exceptions) we may at any rate keep the present species apart.

Pseudoclathria compressa, Carter sp.

Halichondria compressa, Carter, A.M.N.H., December, 1886, p. 450.

This is a very remarkable and easily recognised species, evidently by no means uncommon in the neighbourhood of Port Phillip Heads. The compressed, but thick, flabellate form, with broad, vent-bearing margin, is very characteristic. The rather slender fibres, composed of smooth, straight, slender styli held together by spongin, run chiefly towards the surface, the secondary connecting lines being feebly developed. Mr. Carter speaks of the smooth styli as being curved, but this must be a mistake, for even in his type specimen they are characteristically straight. The short, curved, very richly spined styli, abundantly scattered throughout the sponge, and forming a dense dermal crust, are also very characteristic.

R.N. 371 (18 f.; "orange-red"); 541 (x, 19 f.; "vermilion"); 543 (x, 19 f.; "saturn-red"); 590 (x, 19 f.; "orange-chrome"); 632 (x, 19 f.; "orpiment-orange below deep chrome"); 1041 (x B).

B.M. sp. 28 ("*Halichondria compressa*, C. Type;" Reg. 86-12-15-9).

Art. XVI.—*On the Spectra of the Alkalies.*

By L. Rummel.

(Communicated by R. L. J. Ellery, C.M.G., F.R.S.)

[Read 12th November, 1896].

In the paper I venture to lay before the Royal Society of Victoria, I have attempted to determine the values of the wave lengths of the spectrum lines of the alkalies, as formed into series by Kaiser and Runge, by means of a new formula. To this formula I have given the shape $\lambda^n = x + \frac{y}{n^2 - z}$, λ meaning the wave length, n a whole number, commencing with 2, and x, y, z 3 constants. It requires three equations to determine these constants. Supposing three members of a series, viz., a, b, c, are known to form the series 3, 4, 5, then we get the three equations:

$$a = x + \frac{y}{9 - z}$$

$$b = x + \frac{y}{16 - z}$$

$$c = x + \frac{y}{25 - z}$$

which give the solution:

$$z = 9 - \frac{112(b - c)}{16(a - b) - 7(a - c)}$$

$$y = \frac{(a - b)(9 - z)(16 - z)}{7}$$

$$x = a - \frac{y}{9 - z}$$

If the numerals are respectively 4, 5, 6, the values are:

$$z = \frac{180(b - c)}{20(a - b) - 9(a - c)}$$

$$y = \frac{(a - b)(16 - z)(25 - z)}{9}$$

$$x = a - \frac{y}{16 - z}$$

Different combinations of numerals will of course require different values for a solution, but these are easily determined by deducting their square numbers and multiplying the differences respectively.

I shall refer to the three constants by calling x the root, because it is identical in value to Balmer's constant; y the amplitude, because its square root gives the final number of the series; and z the excentricity, as it determines the shape of the curve.

To ascertain the numerals of a series generally requires repeated trials. If z turns out negative, of course the numerals are wrongly chosen, but even in the case of its acquiring a positive value, the final test applied consists in working out the values and to select the numerals, that accord best with the experimental values. I have thus been forced to change the numerals, as given by Kaiser and Runge, in many instances.

A second difficulty is offered by the degree of exactness of the experimental values. The latter have been supplied by Kaiser and Runge, Liveing and Dewar, Lecoq de Boisbeaudran and Snow, and they do not always accord well. But even the values of one observer may greatly differ in exactness and may cause considerable discrepancies, which will show themselves most markedly in the red and ultrared rays.

Only a few lines do not seem to fit into any series. These lines are all of a slight intensity, they differ sometimes in aspect from the other lines or are omitted by other observers. I therefore conclude them to be due to impurities.

Several series of the same metal may be united either by the same root or the same excentricity or by both combined. In the Table of Wave Lengths I have bracketed those values.

The spectrum lines of each alkali metal seem to form two groups, divided by a large gap or interval, and appear to form two octaves, differentiated by their amplitudes especially. These gaps proceed towards the red with increasing atomic weight.

During the progress of my work I have been assisted by Mr. R. L. J. Ellery, late Director of the Melbourne Observatory, who aided me in solving difficult algebraical questions, and by Mr. W. Sutherland, the author of important works on molecular physics. To these gentlemen I hereby offer my grateful acknowledgment.

Lithium. The three equations, expressing the 3 series, are:

1. $3497 + \frac{15021}{n^2 - 5{\cdot}885} = \lambda^n$
2. $3497 + \frac{13428}{n^2 - 3{\cdot}85} = \lambda^n$
3. $2297 + \frac{5939}{n^2 - 2{\cdot}6535} = \lambda^n$

The line 3838 does not agree closely, but fits exactly into a Balmer formula, viz., $\lambda^n = 3731 \times \frac{n^2}{n^2 - 4}$, the head-line of which is 6708. The series, however, is not continuous.

Sodium is represented by 6 equations, viz.:

1. $4073{\cdot}5 + \frac{20125}{n^2 - 6{\cdot}36} = \lambda^n$
2. $4072 + \frac{20057}{n^2 - 6{\cdot}36} = \lambda^n$
3. $4085 + \frac{18387}{n^2 - 4{\cdot}532} = \lambda^n$
4. $4082{\cdot}5 + \frac{18343}{n^2 - 4{\cdot}532} = \lambda^n$
5. $2416{\cdot}7 + \frac{5946}{n^2 - 2{\cdot}201} = \lambda^n$
6. $2416{\cdot}7 + \frac{5935}{n^2 - 2{\cdot}201} = \lambda^n$

The two lines 5676 and 5670 are omitted as most likely belonging to a foreign metal, perhaps Titanium.

Potassium likewise furnishes 6 equations:

1. $4573{\cdot}5 + \frac{18865}{n^2 - 1{\cdot}022} = \lambda^n$
2. $4562 + \frac{18742}{n^2 - 1{\cdot}022} = \lambda^n$
3. $4578 + \frac{18170}{n^2 - 1{\cdot}153} = \lambda^n$
4. $4566 + \frac{18062}{n^2 - 1{\cdot}153} = \lambda^n$
5. $2860 + \frac{8151}{n^2 - 2{\cdot}133} = \lambda^n$
6. $2860 + \frac{8133}{n^2 - 2{\cdot}133} = \lambda^n$

TABLE OF WAVE LENGTHS OF THE ALKALIES.

—	LITHIUM.				SODIUM.						POTASSIUM.						RUBIDIUM.				CAESIUM.			
A.	1 & 2.	B.	3.	B.	1 & 2.	B.	3 & 4.	B	5 & 6.	B.	1 & 2.	B.	3 & 4.	B.	5 & 6.	B.	1 & 2.	B.	3 & 4.	B.	1 & 2.	B.	3 & 4.	B.
2			6708	6708					5896 5890	5896 5890	10908 10855	11550 10860	10927 10877	12200 11550	7226 7215	7699? 7666?	14162 13876	14750 13180	7562 7401	8450?	26317 24923		8341 7945	8330
3	8323 6104	8110 6104	3233	3233	11696 11669	11320	8200 8188	8200 8188	3303 3301	3303 3302	6936 6909	6939 6911	6893 6868	6911?	4047 4044	4047 4044	7729 7602	7950 7811	4216 4202	4216 4202	9099 8743	9000 8820	4593 4555	4593 4555
4	4972 4602	4972 4602	2741	2741	6161 6155	6161 6155	5689 5683	5688 5683	2853	2853	5832 5812	5832 5813	5802 5783	5802 5783	3447 3446	3447 3446	6299 6207	6299 6207	3592 3587	3592 3587	6974 6724	6974 6724	3889 3877	3889 3877
5	4273 4132	4273 4132	2562	2563	5153 5148	5154 5149	4984 4979	4984 4979	2679	2680	5360 5343	5360 5343	5340 5323	5340 5324	3217 3215	3218 3217	5725 5647	5724 5648	3351 3349	3351 3349	6214 6010	6213 6011	3617 3612	3617 3612
6	3986 3914	3986 3915	2475	2475	4752 4749	4752 4748	4669 4666	4669 4665	2593	2594	5113 5098	5113 5098	5100 5084	5100 5084	3101 3100	3102 3102	5433 5362	5432 5363			5843 5663	5845 5664		
7	3845 3794	3838 3795	2425	2426	4545 4542	4546 4543	4499 4494	4500 4494	2544	2544	4967 4952	4965 4952	4957 4943	4957 4943	3034 3033	3535	5263 5196	5260 5195			5637 5468	5635 5466		
8	„ 3720	3719	2394	2395	4422 4420	4424 4420	4394 4391	4394 4391	2514	2512	4874 4859	4871 4857	4867 4853	4864 4851	2992 2991	2992	5155 5091	5162 5086			5506 5345	5502 5346		
9	„ 3671	3671	2373	2374	4343 4341	4344 ?	4325 4323	4326 ?			4810 4796	4809 4797	4805 4792	4804 4789	2963	2963	5082 5020	5086 5022			5419 5262	5411 5258		
10			2357	2359							4764 4751	4760			2943	2943					5357 „	5346?		
11																					5313 „	5311		

Column A contains the serial number. Columns B, B the experimental wave lengths. Columns 1, 2, 3, 4, 3, 5, 6 the calculated values.

The head-lines of 5 and 6 differ greatly from the experimental values. The equations

$$5.\quad 2865+\frac{7822}{n^2-2{\cdot}382}=\lambda^n$$

$$6.\quad 2865+\frac{7822}{n^2-2{\cdot}371}=\lambda^n$$

would put them and the other lines into perfect accord, excepting the two pairs $\left\{\begin{matrix}3447\\3446\end{matrix}\right.$ and $\left\{\begin{matrix}3218\\3217,\end{matrix}\right.$ which would be reduced to $\left\{\begin{matrix}3440\\3439\end{matrix}\right.$ and $\left\{\begin{matrix}3211\\3210.\end{matrix}\right.$ Perhaps an error has been committed.

Rubidium. Three of the lines, viz., 6160, 6071 and 5654 are not included in my equations. The first of the three lines looks suspiciously like the Sodium line 6161, and the other two lines may be due to Iron or Titanium. The four equations are:

$$1.\quad 4815\quad+\frac{21171}{n^2-1{\cdot}735}=\lambda^n$$

$$2.\quad 4759{\cdot}5+\frac{20649}{n^2-1{\cdot}735}=\lambda^n$$

$$3.\quad 2981\quad+\frac{8452}{n^2-2{\cdot}155}=\lambda^n$$

$$4.\quad 2981\quad+\frac{8428}{n^2-2{\cdot}093}=\lambda^n$$

Caesium. Only one line, viz., 5579 has not been included in the four equations which are:

$$1.\quad 5104+\frac{24607}{n^2-2{\cdot}84}=\lambda^n$$

$$2.\quad 4965+\frac{23151}{n^2-2{\cdot}84}=\lambda^n$$

$$3.\quad 3199+\frac{9564}{n^2-2{\cdot}14}=\lambda^n$$

$$4.\quad 3199+\frac{9492}{n^2-2}=\lambda^n$$

In conclusion I may say, that the above formulas do not pretend to be final, but to draw the attention of physicists to a novel way of ascertaining the members of the series of other spectra and to determine, which lines are essential and which are due to foreign bodies.

Art. XVII.—*On the Variations in the Spinal Nerves of Hyla aurea.*

By Miss Georgina Sweet, B.Sc.

(Communicated by Professor Baldwin Spencer).

[Read 12th November, 1896.]

During the years 1893 and 1895 there appeared two papers by Dr. Hermann Adolphi, on the Variations of the Spinal Nerves of three of the European Anura, *Bufo variabilis*, *Pelobates fuscus*, and *Rana esculenta*. Comparatively little being known of the more minute details in the morphology of the Australian Amphibia, it was the wish of Professor Spencer that I should undertake a similar work in connection with some of our Australian forms. Accordingly, in April of this year, I commenced my observations on the nerves of *Hyla aurea*, the common green frog of Victoria, in the Biological Laboratory at the Melbourne University, and my thanks are due to Professor Spencer for his kindly help and advice given during the progress of this work.

On each side of the spinal column there are given off generally, ten nerves, as in the European forms, *Rana esculenta*,* and *Bufo variabilis*.† The first nine pairs, as usual pass through the intervertebral foramina, and the tenth pair through the canalis coccygeus in the urostyle. Occasionally in *Hyla aurea* there is found an eleventh nerve on each side, which, like the tenth to which it is posterior, passes out by a foramen in the urostyle.

As in the Anura generally, there is no representative of the first spinal nerve or sub-occipital, shown by Fürbringer to be present in the Urodeles, where it passes out between the skull and first vertebra; and in *Pipa dorsigera*, among the Anura, there piercing the first vertebra.

Nerve II., the Hypoglossal, is somewhat thin, and passes out between vertebræ I. and II. It then runs in a straight line

* Ecker: Anatomy of the Frog (English Translation, Haslam), p. 175.

† Adolphi: Morphologisches Jahrbuch, 1893, p. 316.

toward the side of the body for some distance, and turning sharply, often at an angle of almost ninety degrees, runs forwards to supply the muscles of the tongue. In a very few cases I observed that the hypoglossal divided into two parts which united again a little farther on, leaving a space through which the carotid artery passed towards the head. Between the hypoglossal and pneumogastric nerves there passed in one or two instances a twig of communication which, however, was very fine. Haslam mentions a similar connection as having been described by Hoffmann for *Rana*,* though he himself has not noticed it. The relations of II. with the brachial plexus are varied. Most frequently II. has no connection with the brachial plexus as stated by Adolphi for *Bufo variabilis*. Sometimes a branch passes from II. to join either III. itself, or else the coraco-clavicular branch of III. (cf. *Rana esculenta*, as stated by Weidersheim, Fürbringer, and Hoffmann).† In a few instances in *Hyla aurea*, we find that II. is fused with III., and where this is the case, a nerve corresponding in destination to II., and composed also chiefly of II. fibres, leaves III. to run forwards at the same position as that in which II. ordinarily turns forwards. In one specimen, II., divided into two equal parts at its exit from the intervertebral foramen, the anterior half passing out freely, while the posterior half fused with III. as above, leaving it again to join the anterior part as it turned forwards. According to Ecker‡ this fusion is not uncommon in *Rana*.

III. is the largest of all the spinal nerves. It passes outwards from its origin between vertebræ II. and III., and forms the large Brachial nerve, which supplies the muscles and skin of the arm. While in the trunk, it gives off a branch of considerable size, forming the *Coraco-clavicularis* nerve, which supplies the *Deltoideus*, *Sterno-radialis*, *Transverso-scapularis*, and *Obliquus abdominis internus* muscles. As stated above, a branch from II. sometimes joins III. or the coraco-clavicular. Very rarely I found the coraco-clavicular nerve originating from II., with only a small twig from III. Where II. fused with III. entirely, the coraco-clavicular is given off at the same place as II. passes away,

* Ecker: *loc. cit.*, p. 183.

† Ecker: *loc. cit.*, p. 183, also Adolphi, *loc. cit.*, 1893, p. 316.

‡ Ecker: *loc. cit.*, p. 187.

and there may be a branch of communciation between II. and the coraco-clavicular after they have left III. Generally also, a branch passes between III. and IV., most frequently running from III. to IV. Sometimes also IV. is found fused with III. at one point, or rarely, for some distance. Beyond its connection with II. or IV., where such exists, the brachial nerve sends from its posterior side a large branch to the *Latissimus dorsi* muscle, with a twig to the *Infraspinatus* muscle. Then a nerve passes off supplying the skin of the axilla and dorsal surface of the upper arm. A short distance further a large branch runs off to the pectoral muscles, while on its anterior face, the brachial nerve sends off branches to the *Deltoideus* muscle. Just beyond the origin of these nerves, and as the brachial enters the arm, or sometimes somewhat before, it divides, forming the *radialis* and *ulnaris* nerves.

The branches supplied by these two nerves are as follows:—The ulnar nerve passes along the upper arm, merely giving off one or two small branches to the skin of the inner surface. Just above the elbow it gives off a large branch, the *Cutaneus antibrachii inferior* (*dorsalis*), which supplies chiefly the skin of the dorsal surface of the hand. The *Ulnaris* continues its course into the forearm and there gives off the *Cutaneus antibrachii superior* nerve, passing to the skin of the inner side of the forearm. Much lower down, the *Ulnaris* divides into two—the smaller branch—*Ulnaris medialis*—supplies some of the flexor muscles and digit V.: while the larger—*Ulnaris lateralis*—supplies the adjacent sides of the digits II., III., IV., and V.: sending also a branch to the flexor muscles of the palm.

The radial nerve soon after its origin from the brachial gives off twigs to the *Deltoideus* and *Subscapular* muscles. Immediately below this is the *Ramus cutaneus superior* which supplies the skin of the outer surface of the upper arm. Three twigs are then given off to the Triceps muscle, two of these being close to the *Ramus cutaneus superior*, the other arising much lower. When it reaches the forearm the Radial nerve divides into the *Ramus radialis medialis*—which supplies some of the extensor muscles of the hand, the skin, and ends in digit V.—and the *Ramus radialis lateralis* which supplies other of the extensor muscles—and also by bifurcating branches, adjacent sides of the digits II., III., IV. and V.

Nerve IV. passes outwards from its foramen between vertebræ III. and IV., and runs near, and almost parallel to III., with which, as before mentioned, it has a communicating branch, or with which it may sometimes fuse for a longer or shorter distance. IV. is a thin nerve, never even approximating III. in size, as contrasted with *Bufo variabilis* in which IV. is stated by Adolphi* to be sometimes the thickest in the body. It gives off branches to the *Transversa-scapularis major*, very rarely one to the coraco-clavicular, and always, a branch which runs through the *Obliquus abdominis internus* to the *Rectus abdominis* muscle where it branches, and finally ends in the skin, being known as the *Thoracicus inferior* nerve.

Nerves V. to VII. are thin. They pass out obliquely backwards and outwards, and then downwards, on the ventral surface of the *Intertransversarius* muscle, and piercing the *Obliquus internus* divide forming the *Ramus muscularis*, and *Ramus cutaneus abdominalis*, supplying therefore the muscles and skin of the body wall. I have seen no trace of communication between V. and the brachial plexus, such as Adolphi has observed in *Pelobates fuscus*.† But in one case, there was on both sides of the body a well-defined branch passing from VII. to join VIII. above the origin of the ileo-hypogastric nerve.

Nerves VIII. to XI. form the sacral plexus. They pass out from the vertebral column and run backwards parallel with the urostyle into the pelvis, giving rise to the ileo-hypogastric, crural, and sciatic nerves, besides branches to the alimentary canal, oviduct and bladder. Nerve VIII. is generally somewhat thin, and in the great majority of cases forms the *Ileo-hypogastricus* nerve without any assistance from IX., though in a few instances fibres of IX. enter VIII. above the origin of the ileo-hpyogastric, and in one case, two ileo-hypogastrics were present, one composed of VIII. fibres only, the other of IX. fibres only, both having the same destination. In each case where IX. enters into the composition of the ileo-hypogastric, VIII. is somewhat thinner than usual, but VIII. is also thinner when IX. has no connection whatever with the ileo-hypogastric. This nerve divides as in Rana into two branches, the *Ramus*

* Morph. Jahr. xxii., 1895, p. 451. † *Loc. cit.* xxii., 1895, p. 451.

cutaneus abdominalis, which pierces the *Obliquus internus* muscle on its way to the skin, and the *Ramus muscularis*, supplying the abdominal muscles. The rest of the VIII. fibres pass backward to join the sacral plexus. Nerves IX. and X. are thick, IX. being generally the thicker of the two. The crural nerve generally consists of fibres from VIII. and IX. in almost equal proportions, and may contain fibres from X. or not, according as X. joins IX. above or below the origin of the *Cruralis*. Occasionally the crural nerve may consist chiefly of IX. fibres with a very small branch from VIII., or more seldom of chiefly VIII. fibres with very few from IX. Very rarely, the crural nerve may be composed of IX. fibres only, the whole of VIII. then forming the ileo-hypogastric, or more often, the *cruralis* consists of VIII. fibres only, in which case VIII. sends down also a branch to enter the sciatic nerve. As in Rana, the crural nerve runs out to the thigh and there lies upon the *Ilio-psoas* muscle in an angle between the *Adductor magnus*, and the *Rectus femoris anticus*. By far its larger branch, the *Ramus cutaneus femoris* supplies the skin while other branches supply the *Adductores longus* and *brevis*, *Ilio-psoas*, *Vastus internus*, and sometimes the *Rectus femoris anticus* and *pectineus*. From the fusion of IX. and X. arises the sciatic nerve, which supplies all those parts of the leg to which the *cruralis* does not send branches. It may or may not contain any fibres from VIII. according to the manner in which VIII. is connected with the sacral plexus, *i.e.*, whether it joins IX. above the origin of the crural from IX., or joins the crural itself.

The sciatic nerve most frequently consists of almost equal quantities of IX. and X alone, though often VIII. fibres enters into its composition and rather less frequently XI. fibres, while very rarely indeed X. forms the bulk of the sciatic, which then also contains very few IX. fibres; or it may be chiefly IX., in which case X. is a thin nerve, and VIII. fibres are always present. The sciatic nerve runs backwards and enters the thigh having almost the same relations as in *Rana*. While still in the body it gives off a branch—*Ramus cutaneus femoris posterior*—which supplies the skin of the ventral and inner sides of the thigh; and also sends a twig to the *Rectus internus minor*. In its course down the thigh, the sciatic gives off several branches

to the *Semimembranosus*, to both heads of the *Semitendinosus*, and to its posterior portion, to the inner surface and body of the *Adductor magnus*, to the *Biceps*, and to the *Rectus internus major*. Beneath the *Biceps* the sciatic divides, forming the *Tibialis* and *Peroneus*. The former passes down the leg to the foot, giving off nerves supplying the skin, the *Gastrocnemius*, the *Tibialis posticus*, the flexors of the fingers, the *Abductor hallucis*, and lower down divides into two nerves, the one supplying the ventral surface of the digits, and the other the deep or under-surface of the muscles of the sole. The second division of the sciatic, the peroneal, gives off immediately after its origin, nerves to the skin. It then divides into two—one half lies between the surrounding muscles and gives off branches to the *Tibialis anticus*, *Peroneus*, and *Flexores tarsi anterior* and *posterior*. The other half runs straight through the substance of the *Extensor cruris brevis*, to which it gives off a small branch, and continues down to the ankle, where it joins the other half, close to the bone, and below the *Flexor tarsi posterior*. Just before it unites, however, a branch is given off running to the skin and extensors of digits IV. and V., while the large nerve, formed by the junction, runs down to supply the extensors of digits I., II. and III., and the skin of the toes. This peculiar branching and junction of the peroneal nerve would appear to be the same as that described by Ecker for *Rana**—where the *Peroneus medialis* joins the *Peroneus lateralis*, forming a common stem, the *peroneus communis inferior*.

The XIth. nerve is a thin nerve, and may have a direct or an indirect connection with the sacral plexus. In the former case, in which XI. always take some part in the formation of the sciatic nerve, the whole nerve may enter X., or it may join X. by two or more of its own branches, either passing entirely into X. in this way, or sending down a branch which has an indirect communication with X. This latter means of connection is by far the most frequent, and is seen in instances where branches of XI. join branches of X. or of the sciatic, often forming a network.

Nerve XII., which Adolphi mentions as occurring in one per cent. cases in *Bufo variabilis*, and very rarely in *Pelobates fuscus*,

* Ecker: *loc. cit.*, p. 196.

I have found present in 3·2 per cent. cases in *Hyla aurea*, in each of which it either joins XI. directly or joins the network formed by the branches of X. and XI. This plexus supplies branches to the *Coccygeus* and *Levator ani* muscles, and to the bladder, cloaca, and oviduct; while, in addition, the last three seem sometimes to have nerve fibres from XI. only.

The thickness of a nerve is an essential element in deciding which is its more primitive, and which its more advanced, condition. I have therefore drawn up a series of tables comparable to those made by Adolphi for *Bufo variabilis* and *Pelobates fuscus*.

As a basis for the valuation, I have taken (1) the most frequently occurring thickness of nerve VI., the central nerve of those three which do not send any fibres to the limbs, as thickness 4. As in *Bufo variabilis*, nerves V., VI., and VII. have generally very nearly the same thickness, and as a rule in animals of approximately equal size, these three nerves have also about the same thicknesses. VII. is generally the same thickness as V. and VI. sometimes slightly thicker or thinner. In the one case in which I found any connection between it and the sacral plexus, VII. had one of the smaller thicknesses noted for that nerve. (2) The most frequently occurring thickness of nerve IX., in the sacral plexus, is represented as thickness 9. The figures 0 to 19 show, of course, only the relative thickness of the nerves, though in such a manner that for each increase in the absolute thickness of ·1 millimetre, there is an increase of 1 in the relative thickness; *e.g.*, thickness 4 corresponds to ·3 millimetres, thickness 5 to ·4 millimetres and so on.

So that this may be clearer I have drawn a curve showing the exact value of the separate thicknesses 0 to 19. Along the horizontal line are placed the numbers of the relative thicknesses consecutively, while the vertical represents the actual value of those separate thicknesses, increased some twenty times.

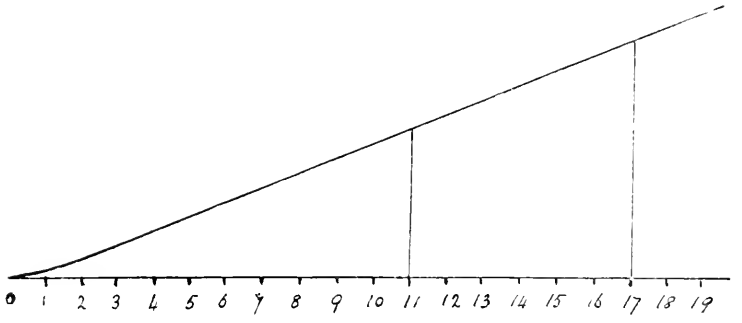

Fig. A

So far as I am able to judge from the data given by Adolphi, the numbers thus arrived at should be quite comparable with his.

I have examined 125 specimens of *Hyla aurea*, and instead of regarding, as Adolphi has done, each specimen as yielding two separate observations, one for each side, I have considered it as one observation, or where the two sides differ from one another as two half observations. This does not interfere with the comparison of the two sets of tables, as the percentage relations are not affected thereby. The following results are brought together in Table A.*

Nerve XII., as I have mentioned above, was found in 3·2 per cent. of all cases—of these 2·4 per cent. had thickness 1, and ·8 per cent. thickness 2.

Nerve XI. varies in thickness from 1 to 6—The majority of cases, 88·8 per cent. were divided between thicknesses 2 and 3, the former having 46·4 per cent., the latter 42·4 per cent. Thickness 4 and over occur but seldom. This nerve was present in every case, as constrasted with *Bufo variabilis*.†

In Nerve X. we find a wide range of thickness, viz., from 3 to 12. The majority, 82·4 per cent. are found among thicknesses 7 to 10. Thicknesses 4 to 6 are seldom seen, and 3, 11, and 12 very seldom.

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* All Tables referred to are placed at the end of the memoir.

† *Loc. cit.*, 1893, p. 321.

Nerve IX. has thicknesses 6 to 11 and 16, the latter, however, occurring only in one out of the 125 cases. 85·6 per cent. of all cases have thickness 8 to 10, the greater number of these having thickness 9.

Nerve VIII. Thicknesses 3 to 8 are present: 3 to 5 being most frequent, occurring in 88 per cent. of all cases—of these 39·2 per cent. have thickness 4. Thicknesses 6, 7, 8, occur in 6, 4, and 2 per cent. of cases respectively.

Nerve VII. varies in thickness from 2 to 5. Thicknesses 2 and 5 are seldom met with—while thickness 3 occurs in 27·2 per cent., and thickness 4 in 65·6 per cent. of all cases, these two thicknesses having thus a total of 92·8 per cent.

Nerve VI. Thicknesses 3 to 6 occur, 5 and 6, however, but rarely—thickness 3 was found in 36 per cent., and thickness 4 in 59·2 per cent. of all cases—total for thicknesses 3 and 4 being thus 95·2 per cent.

Nerve V. varies from 1 to 5 in thickness: 91·2 per cent. of the cases having thickness 3 or 4, while thicknesses 1 and 2 occur very seldom.

Nerve IV. We find here thicknesses 2 to 6 of which 2 and 6 are each only met with in ·8 per cent. of cases. Thicknesses 3 and 4 are equally frequent, each occurring in 44 per cent. of all cases, while in 10·4 per cent. of cases we find thickness 5.

Nerve III. has a considerably greater thickness than IV., the smallest thickness seen here being 7, and that only in one instance (·8 per cent.)

On the other hand, the greatest thickness seen was 19, this also occurring in only one instance (·8 per cent.). Of the intermediate thicknesses, I observed from 9 to 15 only, of which 80·8 per cent. cases were distributed between thicknesses 11, 12 and 13; 12, the most frequent, being found in 40 per cent. of all cases.

Nerve II. varies in thickness from 3 to 6. By far the greatest number of instances 79·2 per cent., or about three-fourths, have thickness 4, while thickness 5 occurs in 12 per cent. of cases: thicknesses 3 and 6 are not often found in connection with nerve II.

In comparing Table A with the corresponding Table for *Bufo variabilis*,* the following are the principal differences noticeable:—

* Adolphi, *loc. cit.*, p. 321.

While in *Bufo variabilis*, nerve XII. only occurs in one per cent. of all cases, in *Hyla aurea*, it was noted in 3·2 per cent. Nerve XI., which was found to be absent in 4·5 per cent. cases in *Bufo variabilis*, was never absent in *Hyla aurea*, and while in the latter, the smallest thickness (1) is very rare (1·6 per cent.), the next thickness being the most common, in *Bufo variabilis* the smallest is the most frequent (36·5 per cent.).

In *Hyla aurea*, nerve X. has a much wider range of thickness than in *Bufo variabilis*, and while in the latter the greatest number of cases, have the greatest thickness noted for that nerve (9), in *Hyla aurea* we find that the greatest number of cases have thickness 8, which is in the centre of the range for that nerve (3 to 12), the number of cases in which other thicknesses are found gradually increasing up to 27·2 per cent. cases for thickness 8, and then gradually decreasing again. A similar difference is seen when we compare the percentages for nerve IX. In *Bufo variabilis* we again find the greatest thickness 9, in the greatest number of cases (54 per cent.), the percentage occurrence increasing with the increasing thickness up to that point, while in *Hyla aurea* we see that the percentage increases with an increase in thickness up to 9 in the centre of the range for this nerve, and then diminishes with a further increase in thickness. In nerve VIII. there is no marked difference. In *Bufo variabilis* 97·9 per cent. of the cases are divided between the three least thicknesses (4 to 6), and in *Hyla aurea* 88 per cent. are distributed between the three least thicknesses, which, in this case, are 3 to 5. For nerves VII., VI. and V. in *Bufo variabilis* we have no data for comparison, but in *Hyla aurea* we find that for each nerve thicknesses 3 and 4 have by far the greatest number of cases, 4 always preponderating in this respect over 3.

Nerve IV. in *Hyla aurea* has a much more restricted range than in *Bufo variabilis*, and while in this form, two-thirds of the cases have the smallest thickness (4), in *Hyla aurea* thicknesses 3 and 4 are found in a total of 88 per cent. of all cases, the smallest thickness (2) being very rare (·8 per cent.).

Nerve III. The differences between the percentages for this nerve in the two species recall those noted in the case of nerves X. and IX. While in *Bufo variabilis* the greatest number of

cases (95 per cent.) have the greatest thickness (12), in *Hyla aurea* we find that the central thickness (12) of the range has the greatest number of instances (40 per cent.), with a gradual increase in percentage up to this, and then a gradual decrease.

It will be noticed that both nerves IX. and III. in *Hyla aurea* reach a greater thickness than any other nerve in one case in each nerve, and also that the 3 or 4 thicknesses below these extremes are not met with.

Nerve II. In both *Bufo variabilis* and *Hyla aurea* the great majority of instances have the smallest thickness but one, being in the former, thickness 5, in the latter, thickness 4.

It has been found from observations on the larvæ of several of the Anura,‡ that in the tail of the larva are several pairs of spinal nerves which disappear during metamorphosis. Between this and the adult, intervene stages in which nerves X., XI. and XII., have in succession the following thicknesses 9, 4, 1; 8, 2, 0; 7, 1, 0, and sometimes 6, 0, 0. But since we must regard the larval condition as similar to that of the ancestors of that animal, the first of the above four stages is the most primitive, and the last the most highly advanced. From this reduction of the most posterior spinal nerves in order, we can deduce the most primitive and the most advanced condition of spinal nerves anterior to these. For this purpose it is necessary to proceed from these most posterior nerves to those in front of them.

The following Tables, B, 1 to 28, show all the combinations of thicknesses found in those specimens of *Hyla aurea* examined.

Tables B, 1 to 8 show the various thicknesses with which nerve XII. occurs, but owing to the few specimens containing examples of this nerve we cannot rely too much on results obtained from them, unless as confirming other results.

1. While XII. decreases, XI. increases. Thickness 1 of nerve XII. is found with the higher thicknesses 3 and 5 of nerve XI., while thickness 2 of XII. is only found with thickness 2 of nerve XI.

2. While XII. decreases, X. increases. Nerve XII., thickness 1, is only found with the higher thicknesses 6, 7, 8, 9, of nerve X.; and nerve XII., thickness 2, with nerve X., thickness 5.

‡ Adolphi: *loc. cit.*, 1893, p. 335.

3. While XII. decreases, IX. increases. Nerve XII., thickness 2, is only found with nerve IX., thickness 9, while nerve XII., thickness 1, is also found with nerve IX., thickness 11.

4. While XII. decreases, VIII. decreases also. Nerve XII., thickness 2, is found only with nerve VIII., thickness 5, while nerve XII., thickness 1, is found also with nerve VIII., thickness 3.

5. While XII. decreases, IV. increases. Nerve XII., thickness 2 is only found with nerve IV., thickness 3; while nerve XII., thickness 1 is also found with nerve IV., thickness 4.

6. While XII. decreases, III. decreases also. Nerve XII. only occurs with the central thicknesses of the series for nerve III.: but these appear to show that nerve III. decreases with nerve XII. Thus: Nerve XII., thickness 2 is only found with III., thickness 12, while thickness 1 of nerve XII. is also found with nerve III., thicknesses 10 and 11.

7. This table shows no regularity whatever.

8. While XI. diminishes, so does X. In the higher thicknesses of nerve X., there are some irregularities, but from thickness 10 downwards, nerve XI. seems to decrease in thickness as nerve X. also diminishes. The frequency of nerve X., thickness 10, diminishes almost regularly with the decreasing thickness of nerve XI., and was never noted in combination with thickness 1 of nerve XI. The frequency of nerve X., thickness 9, decreases with a falling thickness of nerve XI., reaching a minimum with nerve XI., thickness 2. The frequency of nerve X., thickness 8, increases and then decreases with decreasing thickness of nerve XI., and in the smaller thicknesses of nerve X., the frequency increases with a diminishing thickness of nerve XI., as would be expected.

9. This table shows a somewhat irregular combination. While nerve IX. increases, nerve XI. first increases and then diminishes. The frequency of nerve IX., thickness 7, increases with increasing thickness of nerve XI., while nerve IX., thickness 8, and nerve IX., thickness 9, are very irregular.

10. If we overlook irregularities in the smallest and higher thicknesses of nerve VIII., we find that as nerve XI. diminishes, nerve VIII. increases. The frequency of nerve VIII., thicknesses 3 and 4 varies greatly. That of nerve VIII., thickness

5, increases as nerve XI. decreases, also nerve VIII., thicknesses 6 and 7.

11. Nerve XI. and IV. show only a slight relation to one another. As nerve XI. decreases in thickness, the frequency of thickness 3 of nerve IV. increases, reaching its maximum with nerve XI., thickness 2. Independently of irregularities in nerve XI., thickness 1, due probably to the small number of observations here, we find that the frequency of thicknesses 4 and 5 of nerve IV. tend to decrease with decreasing thickness of nerve XI., so that it would appear that nerve IV. decreases with a decreasing thickness of nerve XI.

12. Nerves XI. and III. vary very irregularly, the percentages showing no constant progression. The table shows that the highest thickness 19 of nerve III. is found with a lower thickness (2) of nerve XI., than is the lowest thickness (7) of nerve 3. This may be taken to indicate the fact that while nerve XI. decreases nerve III. increases, but since there are but few observations for those particular thicknesses, it is doubtful how much reliance can be placed on this.

13. The only definite relations shown by this table to exist between nerves XI. and II. is the fact that the smallest thickness (3) of II. only exists with the three smallest thicknesses of nerve XI. The converse is not, however, by any means true. Further, the frequency of the occurrence of intermediate thicknesses gives no information whatever on the variations of nerves XI. and II. The highest thickness, however, 6, of nerve II., does not occur with the two lowest thicknesses of nerve XI. Therefore, probably while nerve XI. diminishes, nerve II. diminishes also.

14. As X. decreases, IX. tends to increase. The two smallest thicknesses of nerve X. are only found with the four highest thicknesses of nerve IX., and rather more frequently with the two highest, 11 and 16, of nerve IX.

15. While X. decreases, VIII. increases. The percentage relations are somewhat irregular; but it will be seen that nerve VIII., thickness 4, reaches a maximum with nerve X., thickness 9; and nerve VIII., thickness 5, with nerve X., thickness 5 (omitting thicknesses 3, 11, and 12, of nerve X., in which there is but a single occurrence), while nerve VIII., thickness 6, has its maximum with nerve X., thickness 4; also nerve VIII., thicknesses 7 and 8, occur chiefly with a lower thickness of

nerve X. (6), than does nerve VIII., thickness 3. We may thus say that there is a tendency for VIII. to increase in thickness as X. decreases.

16. As X. diminishes, IV. may diminish also. Again we find great irregularities. The maximum frequency of nerve IV., thickness 4, independently of single occurrences, is found with thickness 9, of nerve X., while that of nerve IV., thickness 3, is found with nerve X., thickness 7. On the other hand nerve IV., thickness 2 occurs only with nerve X., thickness 9, and nerve IV., thickness 6, only with nerve X., thickness 8.

17. If we examine first the smaller thicknesses 10 to 12, of nerve III., we find a tendency for nerve III. to decrease in thickness with a decreasing thickness of X. But thicknesses 13 and 14, of nerve III., appear to directly oppose this, since their maxima of frequency occur with the lower thicknesses of nerve X. On the other hand, however, the table as a whole (exclusive of thickness 19, of nerve III.), would appear to show a decrease in nerve III. with a decrease in nerve X.

18. As X. decreases, II. decreases also. The frequency of thicknesses 3 and 4, of nerve II., seem to point to a decreasing thickness of nerve II., corresponding to a falling thickness of nerve X.

19. While IX. increases, VIII. increases also. The relations between these two nerves are very indefinite, but there is evidently a tendency for an increase in thickness of nerve VIII. to accompany an increasing thickness of nerve IX., as seen in the position of the maxima of frequency of thicknesses 4, 5, and 6 of nerve VIII., with thicknesses 7, 10, and 10 of nerve IX.

20. While IX. increases, IV. increases also. The frequency of nerve IV., thickness 3, reaches a maximum with nerve IX., thickness 7; nerve IV., thickness 4, with nerve IX., thickness 9; and nerve IV., thickness 5, with nerve IX., thickness 11; while nerve IV., thickness 2, is found with nerve IX., thickness 8, and nerve IV., thickness 6, with nerve IX., thickness 11.

21. While IX. increases, III. increases also. The lowest thicknesses, 7 and 9, and highest, 14 to 19, of nerve III., bear evidence rather in favour of this statement, while the frequency of the intermediate thicknesses of nerve III., *i.e.*, 10, 11, 12 and 13, reach their maxima with nerve IX., thicknesses 7, 9, 10 and 11 respectively.

22. Nerves IX. and II. show no decided relations with one another. The frequency of nerve II., thickness 3, 4 and 5, reaches its maxima with nerve IX., thicknesses 10, 7 and 11 in order. This might be understood to indicate increase in the two nerves. On the other hand nerve II., thickness 3, occurs chiefly with nerve IX., thickness 10, and nerve II., thickness 6, with nerve IX., thickness 9.

23. While VIII. increases, IV. increases also. Nerve IV., thickness 2, only occurs with nerve VIII., thickness 3, and nerve IV., thickness 6, only with nerve VIII., thickness 8; also the maxima of frequency of nerve IV., thicknesses 3, 4 and 5, are found with nerve VIII., thickness 6, 7 and 8 respectively.

24. Nerves VIII. and III. probably increase concurrently, though the table appears somewhat irregular. The two smallest thicknesses 7 and 9 of nerve III. are only found with the two smallest thicknesses 3 and 4 of nerve VIII. The maxima of frequency of nerve III., thicknesses 10, 11, 12, 13 and 14, are found severally with nerve VIII., thicknesses 3, 6, 5, 8 and 8.

25. No definite relations appear between nerves VIII. and II. in this table beyond the occurrence of the highest thickness (6) of nerve II. with nerve VIII., thicknesses 3 and 4 only, which may be understood to signify that an increase in VIII., is accompanied by a decrease in II.

26. While IV. decreases, III. decreases, or while IV. increases, III. increases. Independently of slight irregularities in nerve III., thickness 10, we find that there is a gradual increase in thickness of nerve III., corresponding to an increase of nerve IV. This is confirmed by the occurrence of nerve III., thicknesses 15 and 19 with thicknesses 4 and 5 of nerve IV., while nerve III., thicknesses 7 and 9 occur with nerve IV., thicknesses 3 and 4.

27. Nerves IV. and II. appear to have no regular relation between them beyond the fact that nerve II., thickness 3, occurs slightly more frequently with nerve IV., thickness 5, while nerve II., thickness 6, only occurs with nerve IV., thicknesses 3 and 4.

28. This table distinctly shows on the whole an increase in thickness of nerve II., with an increase in thickness of nerve III. Thus nerve II., thicknesses 3, 4, and 5 occur chiefly with nerve III., thicknesses 9, 10, and 13. Further, nerve II.,

thickness 3, occurs chiefly with nerve III., thickness 9, and nerve II., thickness 6, with nerve III., thickness 10.

Comparing the evidence of these tables with that obtained by Adolphi for *Bufo variabilis*, we find that on the whole there is a confirmation of Adolphi's results with reference to the sacral plexus. In Table 9, showing the variations in thickness of nerve XI. accompanying those of nerve IX., there is partly a confirmation and partly a denial, similarly in Table 17 for nerves X. and III. Tables 13 (nerves XI. and II.) and 18 (nerves X. and II.), on the other hand give a somewhat positive result, where in *Bufo variabilis* we see no connection: while Tables 20 (nerves IX. and IV.), 23 (nerves VIII. and IV.), 25 (nerves VIII. and II.) perhaps, 26 (nerves IV. and III.), and possibly 27 (nerves IV. and II.), offer results directly opposed to those obtained from similar tables for *Bufo variabilis:* while Table 28 (nerves III. and II.) exactly compares with Adolphi's results for similar nerves. The chief difficulties are with reference to the brachial plexus. Instead of nerve IV., the most posterior of the brachial plexus in *Hyla aurea*, being in a condition of decrease in thickness as in *Bufo variabilis*, Tables 20 and 23 distinctly show that it is in a condition of increase, Table 11 being the only one disagreeing with this in the slighest degree. Moreover, if this inference be correct, viz., that nerve IV. is in a state of increase in thickness, then by Table 26, nerve III. also must be increasing in thickness, and this result for nerve III. exactly agrees with Adolphi's observations for *Bufo variabilis*. Further, Tables 13, 18, 25, and 27, in which a relation is seen between nerve II. and the other nerves, point to the fact that nerve II. is decreasing in thickness, and this also agrees with *Bufo variabilis*.‡ Assuming that Adolphi's conclusions based on his examination of the larvæ of *Rana temporaria* and *Pelobates fuscus* be correct, that the thicker condition of nerves X., XI., and XII. is the more primitive, if as seems to be the case from the tables in *Bufo variabilis*, a greater thickness of nerve IV. is found with a greater thickness of nerves XI. and X. and *pari passu* with these, the smaller thicknesses of nerves IX., VIII., and III., and *vice versâ*, the smaller thicknesses of nerves XI., X. and

‡ Adolphi: *loc. cit.*, 1893, p. 341.

IV. accompany the greater thicknesses of nerves IX., VIII., and III.; it is not easy at first sight to understand why in *Hyla aurea* while the sacral plexus agrees entirely with that of *Bufo variabilis*, the brachial plexus should show such a marked unconformity with the European forms. The true bearing of this difference in nerve IV., will, however, appear later on in this paper.

Of the other spinal nerves, V., VI., and VII., have a fairly constant and similar thickness, viz., chiefly 3, 4 and 5, the greatest percentage in each having a thickness of 4.

In order to trace the influence of this change in the thickness of the spinal nerves, on their form and position, I have summed up my observations on the relative positions of the nerves forming the two plexuses in a series of figures and tables. Fig. 1 to 4, and Tables C to L relating to the sacral plexus, and Fig. 5 and 6, and Tables M to O to the brachial plexus.

Fig. 1 and Table C show the gradual development by means of which the function of nerve IX. in giving rise to the ileo-hypogastric nerve has been passed on to nerve VIII.

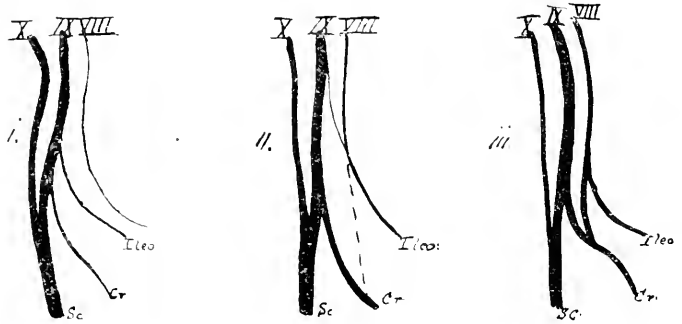

Fig 1.

Looking at Table C and remembering the results which we obtained from the previous set of tables, that the smaller thicknesses of nerve VIII. are the more primitive, and the highest the most advanced—we see that without any question form iii. is the most advanced, for it not only is the sole one occurring with all the thicknesses from the lowest to the highest, but it gradually increases in frequency with an increasing thickness of nerve VIII., until with thicknesses 5 to 8 it reaches 100 per

cent., being the only form having those thicknesses of nerve VIII. On comparing this with Fig. 1, form iii. (to which the Table C, iii. refers), we find that the ileo-hypogastric originates entirely from nerve VIII., the remainder of which passes down and unites with a branch from IX. to form the *cruralis*, that is to say, the region supplied by the ileo-hypogastric, is controlled by nerve VIII. only. On the other hand the most primitive form, according to the percentages, should be form i., which only occurs with the smallest thickness of nerve VIII. Fig. 1, form i., shows that in this the most primitive condition, nerve VIII. takes absolutely no share in the formation of the ileo-hypogastric nerve, this as well as the *cruralis* being supplied by nerve IX. only. Between these two forms, i., the most primitive, and iii., the most advanced, we have as an intermediate stage form ii., in which we find VIII. and IX. taking an equal share in forming the ileo-hypogastric. The *cruralis* is variously formed when this is the case, four per cent. of such cases having the position and relations shown by the continuous lines only, and sixty per cent. that shown by both continuous and dotted lines. I have not separated these two forms in the table, as there are but very few observations, and also I shall discuss the progression of the crural nerve in detail later on.

It will thus be seen that whereas the ileo-hypogastric in its more primitive condition originates from nerve IX., as it advances, it tends more and more to become connected with nerve VIII., until in the great majority of the present forms it is only connected with that nerve, thus showing a transference of function forwards, *i.e.*, from IX. to VIII.

A further instance of this was noted in one specimen in which the ileo-hypogastric branch of VIII. received a branch—fine, certainly—from VII. It would thus appear that there is now a tendency for VII. to be drawn into the sacral plexus, and possibly it will, later on, take part in the formation of the crural nerve also, progressing in just the same way as VIII. has done, as may be seen from Figs. 1, 2 and 3. Of this, however, one can only speak with reserve, inasmuch as it only occurred in one specimen, and then not in conjunction with any of the greater thicknesses of VII. or VIII. (VII. having thickness 3, and VIII. thickness 5). Table C shows that by far the most

common form at present is form iii.; this, however, is not frequent with the higher thicknesses, 6, 7 and 8, so that in an isolated case of the more advanced form, one can understand that it might not occur with the greatest thickness, as a strict inference would imply.

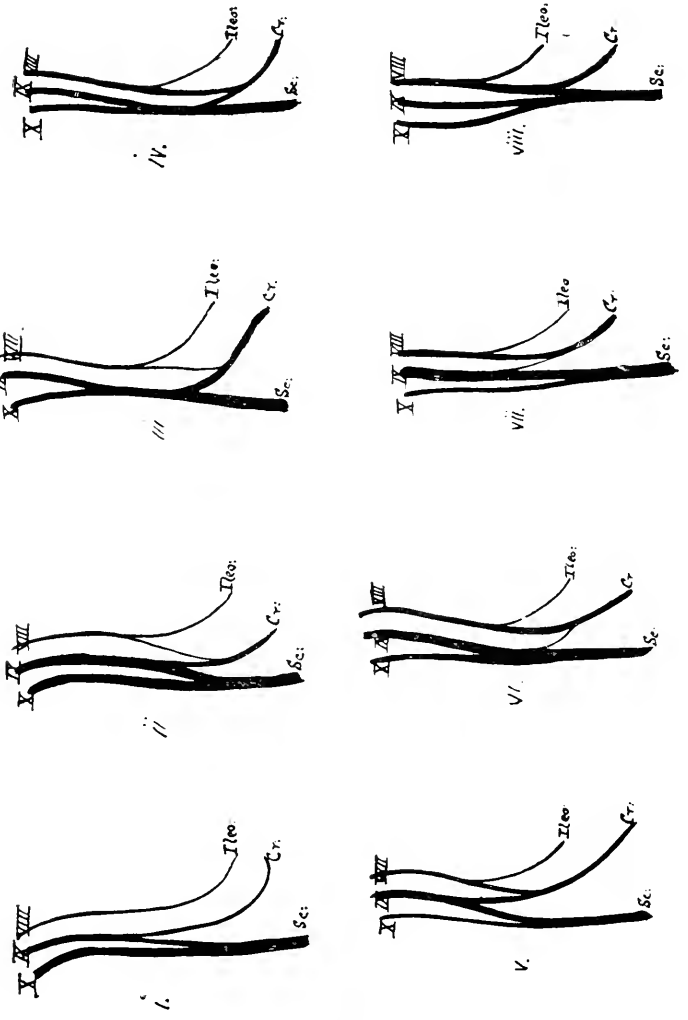

Fig. 2.

Table D and Fig. 2 show a steady progression in the manner in which the *cruralis* originates. Since nerve VIII. is in a condition of increasing thickness, we learn from Table D that the most advanced form is viii., this being the only form occurring with the highest thickness, 8, and also since its greatest frequency, even excluding that with thickness 8, is at least with as high a thickness (7) as that of any other form. Further, we learn from the same source, that form i. is the most primitive, its frequency reaching a maximum with the lowest thickness 3, and gradually decreasing up to thickness 5. Referring to Fig. 2, we see that these two extremes point to the same kind of advancement as took place in the ileo-hypogastric, in other words, we find that in form i., the most primitive, the *cruralis* consists of fibres from nerve IX. only, while in form viii., the most advanced, the fibres come from nerve VIII. only, a transference of function from IX. to VIII., continuing that of the ileo-hypogastric, which, being nearer the exit of the nerve from the spinal cord, seems to lead the way in this respect. Of the intermediate stages, it would seem from the table that ii. is the most primitive, and iii. the next, iv., v., vi. and vii. following in succession. Fig. 2 shows us the following characters for each of these several forms. In form ii., we see that the *cruralis* is formed of chiefly IX. fibres, with a small branch from VIII. In form iii., similar relations exist between the fibres from IX., and from VIII., with the addition of a certain number of fibres from X. The next advance is seen in the greater proportion in the *cruralis* of fibres from VIII., which equals that of the IX. fibres in both iv. and v., the *cruralis* in iv. showing fibres from X., which are absent in v. Up to this, forms i., ii., iii., iv., and v. have occurred from the lowest thickness of VIII. upwards. Form vi., however, does not occur with the lowest thickness 3, showing the next step upwards, while form vii. in the table shows another similar step in advance. In Fig. 2 these two forms vi. and vii. exhibit the same relationships to one another as were seen in the two previous pairs. Thus, in both, the *cruralis* consists chiefly of VIII., with only a small branch from IX., fibres from X. entering into its composition in form vi., but not in form vii. Bearing in mind the general transferrence in the origin of the *cruralis* from IX., and probably previously from X., though of

this we have only indirect evidence, to VIII., we notice in Fig. 3 a gradual but certain advance in this direction.

A somewhat peculiar exception to this is seen in forms ii. and iii. in the figure, which would seem to reverse the natural order, but in the face of the evidence given for those two forms in the table, form iii., certainly occurring with a higher thickness than ii., I have not felt justified in changing the order, though it would certainly appear that a form in which the *cruralis* contains X. fibres, as well as IX. and VIII., would be more primitive than one in which only IX. and VIII. fibres occur. This deviation, however, is not nearly sufficient to nullify the evidence of the rest of the table, which entirely agrees with Adolphi's results for *Bufo variabilis*, viz., that "nerve VIII. originally destined for the body wall (by the ileo-hypogastric) is passed over to take care of the leg (by the *cruralis*), and gradually gains an ever-increasing value in that direction."

I have also drawn up a Table (E), which should show the relations between the thickness of nerve IX. and the form of the *cruralis*, if any exist. There is a somewhat regular progression in forms i. to v., but forms vi., vii., and viii., are very irregular: also

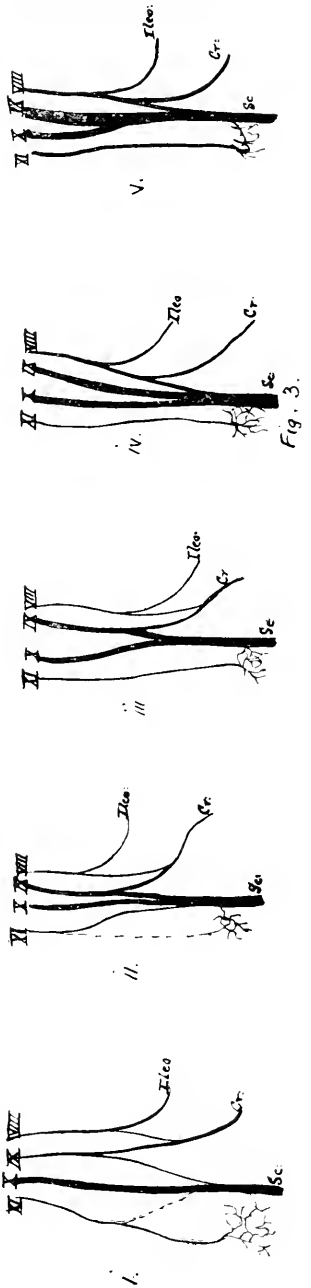

Fig. 3.

we see that the three most primitive forms i., ii., iii., occur with lower thicknesses than the most advanced (viii.).

Tables F, G, H and K, were compiled for the purpose of ascertaining whether the variations in the composition of the sciatic nerve, bear any relation to the variation in thickness of any component nerve.

I find that with the thickness of VIII. (Table F), the only relations noticeable are that form i., which is evidently the most primitive from its occurrence only with two of the smaller thicknesses of nerve VIII., occurs most frequently with a smaller thickness than does form v., which must be the most advanced, since it does not occur with the two smallest thicknesses of VIII. In the three intermediate forms there is a distinct increase in the thickness with which each of the three forms occur most frequently, *i.e.*, form ii. is found most often with thickness 3, form iii. with thickness 4, and form iv. with thickness 7. Thus, although the table as a whole appears somewhat irregular, these two parts would seem to show a distinct advancement *pari passu* with an increase in thickness. The absence of a strict progression is scarcely to be wondered at, since VIII. really only takes any share in the formation of the sciatic in two out of the five forms. This will be clear on reference to Fig. 4.

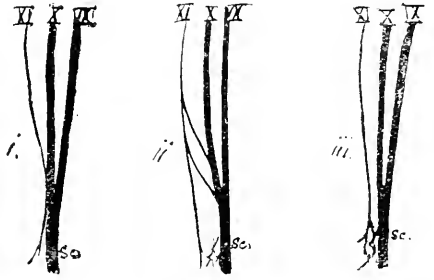

Fig. 4.

In this it will be seen that the progression found in Table F, when compared with the five figures of the forms of that table, offers a confirmation of the forward transference of function found in connection with the *cruralis* and ileo-hypogastric nerves.

In form i. (Fig. 3), we see the sciatic composed chiefly of X. fibres assisted by some from IX., having none from VIII. In forms ii., iii., and iv., X. and IX. enter almost equally into the composition of the sciatic nerve, in form ii. some fibres from XI. enter this union, in iii. we have only X. and IX., in iv. we have the first appearance of VIII. fibres in this nerve. Form v., the most advanced according to Table K, might have been allotted that position by inference from the advance of the four previous forms as seen in the figure, since in it we find the sciatic with a majority of IX. fibres, and also a constant presence of VIII. fibres, X. sinking to a third place in this respect. A further explanation of the irregularity in the maximum percentage frequency in Table K here suggests itself. Just as we find forms ii., iii., and iv., form a complete series in themselves in the table, so we find from the figures that this is also the case, all three coming under a general description, viz., possessing equal quantities of X. and IX. fibres, which forms an intermediate stage between form i. with a majority of X. fibres, and form v. with a majority of IX. fibres.

Table G does not appear to give us any evidence beyond the fact that form i., which we have found to be the most primitive, occurs with a lower thickness than form v., the most advanced. Table H on the other hand shows a well-marked order agreeing with that proved from Table F and Fig. 3. Since nerve X. was found to be in a state of decreasing thickness the most primitive composition of the sciatic ought to occur chiefly with the higher thicknesses, and the more advanced forms in a definite order with the decrease in thickness. Such is the case. Excluding the isolated cases in thickness 11 we find that form i. occurs most frequently with thickness 10, form ii. with thickness 11 and then thickness 9, form iii. with thickness 8, form iv. with thickness 6, and form v. with thickness 3.

Table K showing the relations between the thicknesses of XI. and the composition of the sciatic offers a further confirmation of those results, since we find that XI. being in a decreasing condition, form i. occurs most frequently with thickness 5, form ii. with thickness 5, form iii. with thickness 3, excluding an isolated case in thickness 1, form iv. with thicknesses 2 and 1, while form v. chiefly occurs with thickness 2.

We have yet to describe in connection with the sacral plexus, the further relations which a decreasing thickness of XI. bears to the advancement of the nerves in this region.

According to Table L, nerve XI. being in a state of decrease in thickness, we see that form i. is the most primitive, and form iii. the most advanced, form ii. being an intermediate stage.

Fig. 4 will show the bearing of this on the results of previous tables. In form i. we see the closest connection of XI. with the sciatic nerve, the whole of nerve XI. entering into the composition of the sciatic. In ii., we have nerve XI. entering the sciatic, or joining X. by two or more trunks, while in form iii., XI. has no share in the sciatic at all, merely joining branches of that nerve which supply only the viscera at the posterior end of the body with some of their muscles.

On comparing these results of observations on the sacral plexus of *Hyla aurea* with those made by Adolphi on *Bufo variabilis*, and *Pelobates fuscus*, it will be seen that there is a marked similarity with those results, viz., that the centre of gravity of the sacral plexus is gradually moving towards the head, or in other words, nerves VIII. and IX. increase in thickness as X. and XI. decrease in thickness, and *pari passu* with this change in size and consequent advancement, nerves VIII. and IX. are gradually losing their original relations to the body wall and are assuming a greater importance in the innervation of the leg. It would further appear from the tables relating to the most posterior spinal nerves of *Hyla aurea*, especially XI., that there is at the same time a change whereby these nerves are losing their connection with the leg, and are, and will supply, in its place, the viscera of the hinder part of the trunk, perhaps preparatory to dying out altogether, as XII. is now doing.

It remains to be seen what relations the thickness of the anterior nerves of the spinal column bears to their form.

Since we found in Tables B, 20 and 23, that IV. is increasing in thickness, then the most primitive form of that nerve will occur most frequently with the smaller thicknesses of the nerve. In Table M, therefore, form i. is the most primitive, and form iv. the most advanced, forms ii. and iii. being intermediate stages.

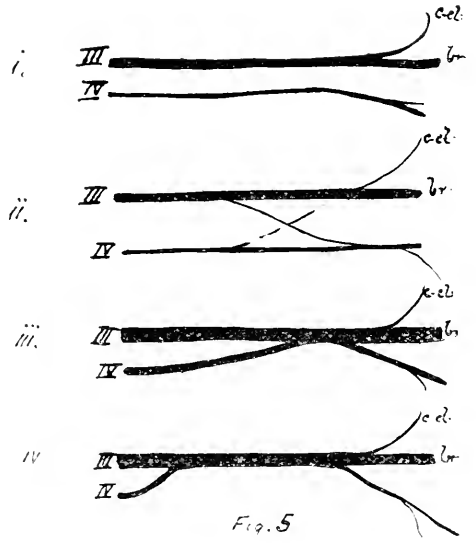

Fig. 5

Fig. 5 shows the following positions of the nerves in the forms i. to iv. In form i., nerve IV. is distinctly free from nerve III.; in form ii. a branch passes between the two nerves, either from nerve III. to IV., or *vice versâ*; in form iii. we find a still closer connection, III. fusing with IV. at one point, while in form iv. the fusion is continued for some distance. But since we found that nerve III. agreed in its manner of increase with that in *Bufo variabilis* and *Pelobates fuscus*, it will be most instructive to take its evidence into consideration.

In Table N then the most primitive form should occur most frequently with the smaller thickness and the most advanced with the higher thickness of nerve III., and according to this table we find that form i., which Table M shows to be the most primitive, occurs chiefly with a lower thickness than does form iv. the most advanced, which so far confirms the previous results. Form iii. shows a slight irregularity in thickness 15, which may possibly be due to the small number of observations in that thickness. It seems therefore that in *Hyla aurea*, as nerve IV. increases in thickness, advancing in development, it takes an increasing share in the formation of the brachial plexus.

With reference to the condition of nerve II. with regard to the brachial plexus, we find the following results :—

Since nerve III. is increasing in thickness, we must regard forms i., ii. and iii. as the most primitive, since they occur mostly or only with the lower thicknesses of III ; forms iv. and v. on the other hand occur not only with the four lower thicknesses of III., but also with the five higher ones. The percentages are somewhat irregular in their progression.

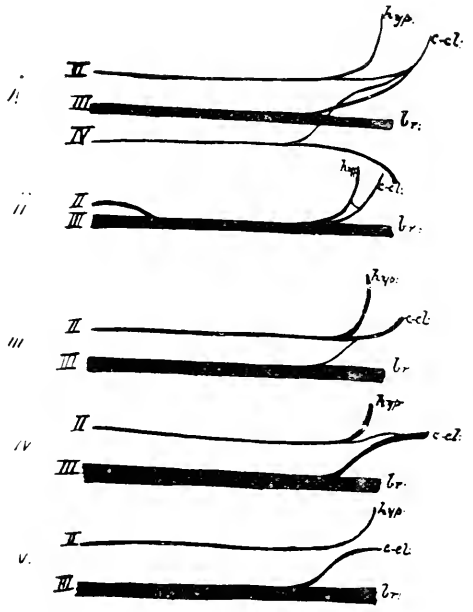

Fig. 6

Fig. 6 shows the positions of the nerves in these forms. In form i. we find a connection of the coraco-clavicular with nerves II. and IV., nerve II. thus taking a share in the brachial plexus. This condition, however, was only found on one side of one specimen and so might be regarded as an aberrant condition. In form ii. we see the closest connection of II. with the brachial plexus, this nerve being fused entirely or in part for some considerable distance with III. In form iii. the connection

is less marked, here the coraco-clavicular is composed chiefly of nerve II. having only a fine branch from III. A modification in the proportions of the fibres from the two nerves would readily give rise to form iv., in which the coraco-clavicular arises as a branch from III. with a few fibres from II. passing either to III. itself or to the coraco-clavicular. In form v., nerve II. has no connection whatever with the brachial plexus. This is what might have been predicted from the fact that IV. is taking an increasing share in the brachial plexus. But when we come to compare with this the Table (P) showing the thicknesses of nerve II. with which these forms are found we meet with a strange discrepancy.

If we regard nerve II. as being in a state of decrease as deduced from Tables 13, 18, 25, etc., we find that the order of the forms in Fig. 6, according to their point of development, beginning with the most primitive, should be v., iv., ii., iii.—excluding i. From this we obtain the remarkable result that as nerve II. *decreases* in size, it assumes fresh duties in addition to those which it had previously. Especially is this unexpected here, as since II., in a diminishing condition, takes upon itself to give rise to the coraco-clavicular, it is difficult to conceive from whence the region supplied by this branch is to derive its nervous supply, as II. diminishes to a thickness of 0. Further, if in the face of Tables B, 13, 18, 25 and 27, we accept the evidence of Table B, 28, viz., that II. increasing in thickness, we merely have the difficulty reversed, for an *increase* in thickness of a nerve is unnecessary for a more and more restricted area of action. I have considered that probably this irregularity is due to the change in habit of *Hyla aurea*, originally an arboreal form, to a terrestrial life. In this connection, it would be interesting to know whether the true Tree frogs of Europe show any deviation from the general combinations of *Bufo variabilis* and *Pelobates fuscus*. In the absence of a more extended knowledge on this point, we may accept for the present, at least, the evidence of Table O, since it seems most in accordance with all the facts relating to nerves IV., III. and II.

The increasing thickness on the part of nerves IV. and III. and the apparent decreasing thickness of nerve II. together with the above tables, indicate the fact that in the brachial plexus of

Hyla aurea we have a further stage of what Bateson calls backward Homœosis of the nerves composing this plexus, in other words that we have here, as in the sacral plexus "an assumption by one member of these Meristic series of the form and characters proper to other members of those series." But, whereas in the sacral plexus, nerves VII. (probably), VIII. and IX. are exercising in an increasing degree the functions previously exerted only by nerves *posterior* to them (viz., IX., X., XI. and XII.); in the brachial plexus, nerve IV. appears to take up new duties previously performed only by II. and III.

We have seen that in the Urodeles and in *Pipa* among the Anura there is a nerve anterior to II., viz., the sub-occipital, which passes out as the case may be between the skull and the first vertebra, or else pierces the first vertebra; also, we found that in *Hyla aurea* as in the Anura generally this is absent.

Pipa thus seems to be, in some degree, an intermediate form between the Urodeles and the other Anura. A further stage is seen in *Rana*, since "the fact that the last spinal nerves to join the brachial plexus in *Pipa* are the IIIrd, while in *Rana* they are IVth, is again an evidence of backward Homœosis."*

That in *Hyla* we have a continuation of the same process is, I think, beyond doubt, since we have an increasing thickness both in III. and IV., concurrent with a decreasing thickness in II., and also a most intimate connection of IV. with the brachial plexus. To sum up the results of these observations on *Hyla aurea*, in a few words, we have found a forward Homœosis in the sacral plexus, also a backward Homœosis in the brachial plexus. We may therefore conclude that in the Anura, as represented by the forms studied in this connection, there is an advancement in the direction of a concentration of the origin and functions of the spinal nerves towards the central region of the body.

APPENDIX.

In addition to *Hyla aurea*, I have examined a few other forms found in Australia, viz., *Helioporus pictus*, and *Limnodynastes*

* Bateson: Materials for the Study of Variation, p. 143.

tasmaniensis from Victoria, and *Limnodynastes ornatus* and *Chiroleptes platycephalus* from Central Australia, for specimens of which, together with those of *Hyla aurea*, I am indebted to Professor Spencer. There being but few observations in each case, I have not attempted to tabulate the results, as a few words with a reference to the figures and tables of *Hyla aurea* will make their size, condition, etc., clear, since here I have taken the same standards for comparison. The manner of distribution and position of the various nerves do not differ very greatly from those of *Hyla aurea*.

In *Helioporus pictus* the various thicknesses found are the following :—

Nerve.	Thickness.	Per cent.	Thickness.	Per cent.
II.	4	50	3	50
III.	5	50	6	50
IV.	6	50	3	50
V.	2	50	2	50
VI.	3	50	2	50
VII.	2	50	3	50
VIII.	3	50	2	50
IX.	7	50	5	50
X.	7	50	5	50
XI.	1	50	2	50

Nerve XII. was not found to occur at all.

The following conditions were observed in the nerves of *Helioporus pictus*.

We find Fig. 1, form ii., with nerve VIII., thickness 2, and Fig. 1, form iii., with nerve VIII., thickness 3, showing with an increase in thickness of nerve VIII. a corresponding advance in the composition of the ileo-hypogastric nerve comparable to that of *Hyla aurea*.

In the *cruralis* we have Fig. 2, form v., occurring with nerve VIII., thickness 2, and nerve IX., thickness 5, and form vii., with nerve VIII., thickness 3, and nerve IX., thickness 7. Thus we see that both the ileo-hypogastric and *cruralis* show here as in *Hyla aurea* a forward Homœosis in the origin of these two nerves, viz., from nerve IX. to nerve VIII., the ileo-hypo-

gastric preceding the *cruralis* because of its position nearer to the spinal column.

In Fig. 3 we find form ii. occurring with nerve VIII., thickness 2, nerve IX., thickness 5, nerve X., thickness 5, and nerve XI., thickness 2; and form iii. with nerve III., thickness 3, nerve IX., thickness 7, nerve X., thickness 7, and nerve XI., thickness 1—that is to say, as nerve VIII. increases, nerve IX. increases, and nerve XI. decreases, there is a decreasing tendency for nerve XI. to take any share in the formation of the sciatic. There is, therefore, here again a forward Homœosis. Nerve X. would seem to offer a slight difficulty in this respect, due probably to the small number of observations.

In Fig. 4 we see again an evidence of this same forward advance in the composition of the sciatic, and in the relations of nerve XI. to the leg, since form i. occurs with nerve XI., thickness 2, and form iii. with thickness 1 of nerve XI., nerve XI. it will be remembered being in a state of decrease.

In Fig. 5, form ii. occurs with nerve III., thickness 6, and nerve IV., thickness 3; and form iii., with nerve III., thickness 5, and nerve IV., thickness 6. Here we see that nerve III. appears to offer a slight deviation from *Hyla aurea*, since it decreases slightly in these few observations. On the other hand, however, nerve IV. increases greatly and as it does so takes an increasing share in the brachial plexus and therefore in the innervation of the fore-limb.

The results with reference to nerve II. are interesting. We find that in Fig. 6, form ii., nerve II. has thickness 3, and in form iii. it has thickness 4. If we premise, that as in *Hyla aurea*, II. is decreasing in thickness, then we have here, it would appear, an increasing connection of II. with the brachial plexus; but reference to Tables P and O will show that Fig. 6, form iii. is a very unusual form in *Hyla aurea*, so that we cannot attach much importance to this fact.

In *Limnodynastes tasmaniensis* we find the following thicknesses :—

Nerve.	Thickness.	Per cent.	Thickness.	Per cent.	Thickness.	Per cent.
II.	3	100	—	—	—	—
III.	5	66·6	8	33·3	—	—
IV.	3	33·3	4	33·3	7	33·3
V.	2	33·3	3	66·6	—	—
VI.	2	66·6	3	33·3	—	—
VII.	3	100	—	—	—	—
VIII.	3	66·6	4	33·3	—	—
IX.	5	100	—	—	—	—
X.	4	33·3	6	66·6	—	—
XI.	2	100	—	—	—	—

Nerve XII. is again absent.

All the specimens have the ileo-hypogastric composed of VIII. fibres only as in Fig. 1, form iii., *i.e.*, at its highest present state of advancement. When nerve VIII. has thickness 3, nerve IX. thickness 5, and nerve X. thickness 6, we find the *cruralis* in the condition drawn in Fig. 2, form v. It consists therefore of equal quantities of nerves VIII. and IX., with no other fibres; X. being absent. With nerve VIII. thicknesses 4 and 3, nerve IX. thickness 9, and nerve X. thicknesses 6 and 4, the *cruralis* finds its highest development, *i.e.*, it contains only fibres from nerve VIII. (*vide* Fig. 2, form viii.).

In all forms, the sciatic has also reached nearly its highest point of development as shown in Fig. 3, form iv., nerves IX. and X. sending equal quantities of fibres to it together with some from VIII. Nerve fibres from XI. are absent from the sciatic, that nerve (XI.) having reached its highest stage, as in Fig. 4, form iii. In the brachial plexus we find with nerve IV. thicknesses 7 and 3 and nerve III. thickness 5, nerve IV. is fused with III. for some distance, Fig. 5, form iv., while we get a branch between III. and IV., Fig. 5, form ii., with nerve III. thickness 8, and nerve IV. thickness 4. When we have nerve III. thicknesses 8 and 5, we find Fig. 6, form iii., *i.e.*, that II. is free from III., and with nerve III. thickness 5 we have a branch between II. and III., *i.e.*, Fig. 6, form iii.

The following observations were made on *Limnodynastes ornatus*. The thicknesses of the nerves were these:—

Nerve.	Thickness.	Per cent.	Thickness.	Per cent.
II.	3	100	—	—
III.	5	50	7	50
IV.	3	100	—	—
V.	2	100	—	—
VI.	2	100	—	—
VII.	2	100	—	—
VIII.	3	50	2	50
IX.	4	50	5	50
X.	5	50	6	50
XI.	2	100	—	—

Nerve XII. was not present.

The ileo-hypogastric always shows its highest development, Fig. 1, form iii. The *cruralis* has reached the stage in which it has only equal quantities of VIII. and IX. (cf. Fig. 2, form v.) We find Fig. 3, form iii., the sciatic being composed of IX. and X. fibres in equal quantities, with nerve VIII., thickness 2, nerve IX., thickness 5, nerve X., thickness 6, and nerve XI., thickness 2, and with the other thicknesses noted for these nerves, we find in addition to IX. and X. fibres, some of VIII. Nerve XI. is entirely absent from the sciatic, having reached its highest development, Fig. 4, form iii.

In the brachial plexus we find Fig. 5, form ii., with nerve IV., thickness 3, and nerve III., thickness 5, and form iii., with nerve IV., thickness 3, and nerve III., thickness 7.

Thus with an increasing thickness of nerve III. we get an increasing importance of IV. in the brachial plexus. Further with an increasing thickness of nerve III. we have an increasing connection of II. with this plexus, since with nerve III., thickness, 7, we have Fig. 6, form ii., and Fig. 6, form iii., with nerve III., thickness 5.

In the specimen of *Chiroleptes platycephalus* from Central Australia, which I examined, I found the following thicknesses: Nerve II., thickness 3, nerve III., thickness 11, nerve IV., thickness 5, nerve V., thickness 3, nerve VI., thickness 2, nerve VII., thickness 3, nerve VIII., thickness 4, nerve IX., thickness 8, nerve X., thickness 5, nerve XI., thickness 2. The ileo-hypo-

gastric was at its highest stage (Fig. 1, form iii.). The *cruralis* had the same relative position as in Fig. 2, form v. The sciatic only contained fibres of nerves IX. and X., as in Fig. 3, form iii., nerve XI. having the relations shown in Fig. 4, form iii.

In the brachial plexus, nerve IV. was in a highly advanced state, similar to Fig. 5, form iii., and nerve II. was quite free from the plexus as in Fig. 6, form iii.

TABLE A.

Nerve XII.			Nerve XI.			Nerve X.			Nerve IX.			Nerve VIII.			Nerve VII.			Nerve VI.			Nerve V.			Nerve IV.			Nerve III.			Nerve II.		
Thick-ness.	No. of Obs.	Per cent.	Thick-ness.	No. of Obs.	Per cent.	Thick-ness.	No. of Obs.	Per cent.	Thick-ness.	No. of Obs.	Per cent.	Thick-ness	No. of Obs.	Per cent.	Thick-ness.	No. of Obs.	Per cent.	Thick-ness.	No. of Obs.	Per cent.	Thick-ness.	No. of Obs.	Per cent.	Thick-ness.	No. of Obs.	Per cent.	Thick-ness.	No. of Obs.	Per cent.	Thick-ness.	No. of Obs.	Per cent.
0	121	96·8	0			0			0			0			0			0			0			0			0			0		
1	3	2·4	1	2	1·6	1			1			1			1			1			1	1	·8	1			1			1		
2	1	·8	2	58	46·4	2			2			2			2	1	·8	2			2	2	1·6	2	1	·8	2			2		
	125		3	53	42·4	3	½	·4	3			3	16	12·8	3	34	27·2	3	45	36·0	3	38	30·4	3	55	44·0	3			3	9	7·2
			4	7	5·6	4	3	2·4	4			4	49	39·2	4	82	65·6	4	74	59·2	4	76	60·8	4	55	44·0	4			4	99	79·2
			5	4	3·2	5	7	5·6	5			5	45	36·0	5	8	6·4	5	5	4·0	5	8	6·4	5	13	10·4	5			5	15	12·0
			6	1	·8	6	8½	6·8	6	2	1·6	6	7½	6·0		125		6	1	·8		125		6	1	·8	6			6	2	1·6
				125		7	25	20·0	7	8	6·4	7	5	4·0					125					125			7	1	·8		125	
						8	34	27·2	8	37	29·6	8	2½	2.0													8					
						9	27	21·6	9	50	40·0		125														9	2	1·6			
						10	17	13·6	10	20	16·0																10	11	8·8			
						11	1	·8	11	7	5·6																11	32	25·6			
						12	2	1·6	12																		12	50	40·0			
							125		13																		13	19	15·2			
									14																		14	6	4·8			
									15																		15	3	2·4			
									16	1	·8																16					
										125																	17					
																											18					
																											19	1	·8			
																												125				

a *1*

TABLE B.

1.—THICKNESS OF NERVE XI.

Thickness of Nerve XII.	1		2		3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
0	2	1·6	56	46·7	52	42·1	7	5·7	3	2·4	1	·8	121
1			1	33·3	1	33·3			1	33·3			3
2			1	100·0									1
Totals	2	1·6	58	46·4	53	42·4	7	5·6	4	3·2	1	·8	125

2.—THICKNESS OF NERVE X.

Thickness of Nerve XII.	3		4		5		6		7		8		9		10		11		12		Totals of Observations
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
0	½	·4	3	2·4	6	4·9	8	7·3	24	19·7	33½	27·6	26	21·4	17	14	2	1·6	1	·8	121
1							½	16·6	1	13·3	½	16·6	1	33·3							3
2					1	100·0															1
Totals	½	·4	3	2·4	7	5·6	8½	7·8	25	20·0	34	27·2	27	21·6	17	13·6	2	1·6	1	·8	125

3.—THICKNESS OF NERVE IX.

Thickness of Nerve XII.	6		7		8		9		10		11		16		Totals of Observations
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
0	2	1·6	8	7·0	37	30·5	47	38·8	20	16·5	6	5·3	1	·8	121
1							2	66·6			1	33·3			3
2							1	100·0							1
Totals	2	1·6	8	6·4	37	29·6	50	40·0	20	16·0	7	5·6	1	·8	125

4.—THICKNESS OF NERVE VIII.

Thickness of Nerve XII.	3		4		5		6		7		8		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
0	15	12·4	49	40·5	42	34·7	7½	6·2	5	4·1	2½	2·0	121
1	1	13·3			2	66·6							3
2					1	100·0							1
Totals	16	12·8	49	39·2	45	36·0	7½	6·0	5	4·0	2½	2·0	125

5.—THICKNESS OF NERVE IV.

Thickness of Nerve XII.	2		3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
0	1	·8	53	43·8	53	43·8	13	10·8	1	·8	121
1			1	33·3	2	66·6					3
2			1	100·0							1
Totals	1	·8	55	44·0	55	44·0	13	10·4	1	·8	125

6.—THICKNESS OF NERVE III.

Thickness of Nerve XII.	7		9		10		11		12		13		14		15		19		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
0	1	·8	2	1·6	10	8·0	31	25·6	48	39·6	19	15.7	6	4·8	3	2·4	1	·8	121
1					1	33·3	1	33·3	1	33·3									3
2									1	100·0									1
Totals	1	·8	2	1·6	11	8·8	32	25·6	50	40·0	19	15·2	6	4·8	3	2·4	1	·8	125

7.—THICKNESS OF NERVE II.

Thickness of Nerve XII.	3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
0	8	6·6	97	80·1	15	12·4	1	·8	121
1	1	33·3	1	33·3			1	33·3	3
2			1	100·0					1
Totals	9	7·2	99	79·2	15	12·0	2	1·6	125

8.—THICKNESS OF NERVE X.

Thickness of Nerve XI.	3		4		5		6		7		8		9		10		11		12		Totals of observations
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
1					1	50·0	1	50·0													2
2	$\frac{1}{2}$	·8	$1\frac{1}{2}$	2·4	5	8·5	$7\frac{1}{2}$	13·0	17	29·3	$12\frac{1}{2}$	21·5	8	13·6	4	6·8	1	1·7	1	1·7	58
3			$1\frac{1}{2}$	2·7	1	1·8			8	15·0	$20\frac{1}{2}$	39·5	15	28·1	6	11·1			1	1·8	53
4											1	14·2	2	28·4	4	56·8					7
5													2	50·0	2	50·0					4
6															1	100·0					1
Totals	$\frac{1}{2}$	·4	3	2·4	7	5·6	$8\frac{1}{2}$	6·8	25	20·0	34	27·2	27	21·6	17	13·6	1	·8	2	1·6	125

9.—THICKNESS OF NERVE IX.

Thickness of Nerve XI.	6		7		8		9		10		11		16		Totals of observations
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
1							2	100							2
2	1	1·7	4	6·8	14	24·1	24	41·3	10	17·2	4	6·8	1	1·7	58
3			2	3·7	18	33 9	20	37·6	10	18·8	3	5·6			53
4	1	14·2	1	14·2	2	28·5	3	42·6							7
5			1	25·0	2	50·0	1	25·0							4
6					1	100·0									1
Totals	2	1·6	8	6·4	37	29·6	50	40·0	20	16·0	7	5·6	1	·8	125

10.—THICKNESS OF NERVE VIII.

Thickness of Nerve XI.	3		4		5		6		7		8		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
1			1	50·0			1	50·0					2
2	7	12·0	16	27·6	27	45·9	4	6·8	3	5·1	1	1·7	58
3	6	11·3	26	49·0	15	28·2	2½	4·7	2	3·7	1½	2·8	53
4	2	28·5	3	42·8	2	28·5							7
5	1	25·0	2	50·0	1	25·0							4
6			1	100·0									1
Totals	16	12·8	49	39·2	45	36·0	7½	6·0	5	4·0	2½	2	125

11.—THICKNESS OF NERVE IV.

Thickness of Nerve XI.	2		3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
1					1	50·0	1	50·0			2
2			35	60·3	20	34·5	3	5·1			58
3			18	33·9	25	47·1	9	16·9	1	1·8	53
4	1	14·2	1	14·2	5	71·6					7
5			1	25·0	3	75·0					4
6					1	50·0					1
Totals	1	·8	55	44·0	55	44·0	13	10·4	1	·8	125

12.—THICKNESS OF NERVE III.

Thickness of Nerve XI.	7		9		10		11		12		13		14		15		19		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
1							1	50·0	1	50·0									2
2			1	1·7	6	10·3	18	30·9	20	34·0	9	15·5	2	3·4	1	1·7	1	1·7	58
3	1	1·8	1	1·8	4	7·6	10	18·8	27	50·9	6	11·2	3	5·6	1	1·8			53
4							2	28·5	1	14·3	3	42·9	1	14·3					7
5					1	25·0	1	25·0	1	25·0	1	25·0							4
6															1	100·0			1
Totals	1	·8	2	1·6	11	8·8	32	25·6	50	40·0	19	15·2	6	4·8	3	2·4	1	·8	125

13.—THICKNESS OF NERVE II.

Thickness of Nerve XI.	3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
1	1	50·0	1	50·0					2
2	4	6·8	45	77·5	9	15·5			58
3	4	7·6	43	81·1	5	9·4	1	1·8	53
4			6	85·7	1	14·3			7
5			3	75·0			1	25·0	4
6			1	100·0					1
Totals	9	7·2	99	79·2	15	12·0	2	1·6	125

14.—THICKNESS OF NERVE IX.

Thickness of Nerve X.	6		7		8		9		10		11		16		Totals of Observations
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
3											½	100·0			½
4							½	16·6	½	16·6	1	33·3	1	33·3	3
5					1	14·2	6	85·2							7
6			1	11·7	2	23·4	4	46·8	1½	17·6					8½
7			1	4·0	8	32·0	10	40·0	3	12·0	3	12·0			25
8	2	5·8	2	5·8	9	26·4	12½	36·7	6	17·6	2½	7·3			34
9			3	11·1	10	37·0	10	37·0	4	14·8					27
10			1	5·8	6	35·2	5	29·4	5	29·4					17
11							1	100·0							1
12					1	50·0	1	50·0							2
Totals	2	1·6	8	6·4	37	29·6	50	40·0	20	16·0	7	5·6	1	·8	125

15.—THICKNESS OF NERVE VIII.

Thickness of Nerve X.	3		4		5		6		7		8		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
3					½	100·0							½
4			1	33·3	½	16·6	1½	49·9					3
5			1	14·2	5	71·0	1	14·2					7
6			1	11·7	4	47·0	1	11·7	1	11·7	1½	17·6	8½
7	5	20·0	10	40·0	8	32·0	1	4·0	1	4·0			25
8	6	17·6	16	47·0	8	23·2			3	8·8	1	2·9	34
9	5	18·5	15	55·5	6	22·2	1	3·7					27
10			5	29·4	10	58·8	2	11·7					17
11					1	100·0							1
12					2	100·0							2
Totals	16	12·8	49	39·2	45	36·0	7½	6·0	5	4·0	2½	2·0	125

16.—THICKNESS OF NERVE IV.

Thickness of Nerve X.	2		3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
3					½	100·0					½
4			½	16·6	1½	49·9	1	33·3			3
5			3	42·6	4	57·0					7
6			4	47·0	3½	41·0	1	11·7			8½
7			20	80·0	3	12·0	2	8·0			25
8			15½	45·5	15½	45·5	2	5·8	1	2·9	34
9	1	3·7	6	22·2	16	59·2	4	14·8			27
10			4	23·5	10	58·8	3	17·6			17
11			1	100·0							1
12			1	50·0	1	50·0					2
Totals	1	·8	55	44·0	55	44·0	13	10·4	1	·8	125

17.—THICKNESS OF NERVE III.

Thickness of Nerve X.	7		9		10		11		12		13		14		15		19		Totals of Observations
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
3											½	100·0							½
4							½	16·6	½	16·6	1	33·3					1	33·3	3
5					1	14·2	2	28·5	2	28·5	1	14·2	1	14·2					7
6					2	23·5	2	23·5	2½	29·4	2	23·5							8½
7					2	8·0	10	40·0	10	40·0	1	4·0	2	8·0					25
8	1	2·9			2	5·8	10½	44·1	17	49·7	3½	10·3							34
9			2	7.4	4	14·8	1	3·7	13	48·1	5	18·5	2	7·4					27
10							6	35·2	5	29·4	2	11·7	1	5·8	3	17·6			17
11											1	100·0							1
12											2	100·0							2
Totals	1	·8	2	1·6	11	8·8	32	25·6	50	40·0	19	15·2	6	4·8	3	2·4	1	·8	125

18.—THICKNESS OF NERVE II.

Thickness of Nerve X.	3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
3					½	100·0			½
4	½	16·6	1½	49·9	1	33·3			3
5	2	28·5	5	71·4					7
6			8½	100·0					8½
7	2	8 0	22	88·0	1	4·0			25
8	2½	7·3	25	73·2	5½	16·1	1	2·9	34
9	1	3·7	22	81·5	3	11·1	1	3·7	27
10	1	5·8	14	82·5	2	11·7			17
11					1	100·0			1
12			1	50·0	1	50·0			2
Totals	9	7·2	99	79·2	15	12·0	2	1·6	125

19.—THICKNESS OF NERVE VIII.

Thickness of Nerve IX.	3		4		5		6		7		8		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
6			2	100·0									2
7	1	12·5	4	50·0	3	37·5							8
8	6	16·2	15	40·5	12	32·4	1½	3·9	2	5·4	½	1·3	37
9	7	14·0	20	40·0	17	34·0	3	6·0	2	4·0	1	2·0	50
10			7	35 0	10	50·0	2	10·0	1	5·0			20
11	2	28·5	1	14·2	3	42·6					1	14·2	7
16							1	100·0					1
Totals	16	12·8	49	39·2	45	36·0	7½	6·0	5	4·0	2½	2·0	125

20.—THICKNESS OF NERVE IV.

Thickness of Nerve IX.	2		3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
6					2	100·0					2
7			5	62·5	3	37·5					8
8	1	2·7	17	45·9	15	40·5	4	10·8			37
9			21	42·0	24	48·0	5	10·0			50
10			9	45·0	9	45·0	2	10·0			20
11			3	42·7	2	28·5	1	14·2	1	14·2	7
16							1	100·0			1
Totals	1	·8	55	44·0	55	44·0	13	10·4	1	·8	125

21.—THICKNESS OF NERVE III.

Thickness of Nerve IX.	7		9		10		11		12		13		14		15		19		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
6							2	100·0											2
7					2	25·0	2	25·0	3	37·5	1	12·5							8
8	1	2·7	1	2·7	4	10·8	7	18·9	15	40·5	4	10·8	4	10·8	1	2·7			37
9					5	10·0	15	30·0	19	38·0	9	18·0	1	2·0	1	2·0			50
10			1	5·0			4	20·0	10	50·0	3	15·0	1	5·0	1	5·0			20
11							2	28·5	3	42·8	2	28·5							7
16																	1	100·0	1
Totals	1	·8	2	1·6	11	8·8	32	25·6	50	40·0	19	15·2	6	4·8	3	2·4	1	·8	125

22.—THICKNESS OF NERVE II.

Thickness of Nerve IX.	3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
6			2	100·0					2
7			7	87·5	1	12·5			8
8	3	8·1	31	83·7	3	8·1			37
9	3	6·0	42	84·0	3	6·0	2	4·0	50
10	3	15·0	13	65·0	4	20·0			20
11			4	57·1	3	42·8			7
16					1	100·0			1
Totals	9	7·2	99	79·2	15	12·0	2	1·6	125

23.—THICKNESS OF NERVE IV.

Thickness of Nerve VIII.	2		3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
3	1	6·2	8	50·0	6	37·6	1	6·2			16
4			20	40·8	24	49·0	5	10·2			49
5			20	44·4	20	44·4	5	11·1			45
6			4	53·3	2	26·6	1½	19·9			7½
7			2	40·0	3	60·0					5
8			1	40·0			½	20·0	1	40·0	2½
Totals	1	·8	55	44·0	55	44·0	13	10·4	1	·8	125

24.—THICKNESS OF NERVE III.

Thickness of Nerve VIII.	7		9		10		11		12		13		14		15		19		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
3	1	6·2			2	12·4	4	24·8	7	43·8	2	12·4							16
4			2	4·0	5	10·2	15	30·6	17	34·7	7	14·3	1	2·0	2	4·0			49
5					4	8·8	9	20·0	20	44·4	8	17·6	3	6·6	1	2·2			45
6							3	40·0	3	40·0			½	6·6			1	13·3	7½
7							1	20·0	2	40·0	1	20·0	1	20 0					5
8									1	40·0	1	40·0	½	20·0					2½
Totals	1	·8	2	1·6	11	8·8	32	25·6	50	40·0	19	15·2	6	4·8	3	2·4	1	·8	125

25.—THICKNESS OF NERVE II.

Thickness of Nerve VIII.	3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
3			15	93·7			1	6·2	16
4	5	10·2	41	83·2	2	4·0	1	2·0	49
5	3	6·6	34	75·5	8	17·7			45
6	1	13·3	3½	46·6	3	40·0			7½
7			4	80·0	1	20·0			5
8			1½	60·0	1	40·0			2½
Totals	9	7·2	99	79·2	15	12·0	2	1·6	125

26.—THICKNESS OF NERVE III.

Thickness of Nerve IV.	7		9		10		11		12		13		14		15		19		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
2									1	100·0									1
3	1	1·8	1	1·8	4	7·2	19	34·5	23	41·8	5	9·0	2	3·6					55
4			1	1·8	7	12·6	11	20·0	20	36·0	13	23·6	2	3·6	1	1·8			55
5							2	15·3	5	38·4	1	7·6	2	15·3	2	15·3	1	7·6	13
6									1	100·0									1
Totals	1	·8	2	1·6	11	8·8	32	25·6	50	40·0	19	15·2	6	4·8	3	2·4	1	·8	125

27.—THICKNESS OF NERVE II.

Thickness of Nerve IV.	3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
2			1	100·0					1
3	4	7·2	44	80·0	6	10·9	1	1·8	55
4	4	7·2	44	80·0	6	10·9	1	1·8	55
5	1	7·6	10	77·0	2	15·3			13
6					1	100·0			1
Totals	9	7·2	99	79·2	15	12·0	2	1·6	125

28.—THICKNESS OF NERVE II.

Thickness of Nerve III.	3		4		5		6		Totals of Observations.
	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	No. of Obs.	Per cent.	
7			1	100·0					1
9	1	50·0	1	50·0					2
10			10	90·9			1	9·0	11
11	7	21·8	22	68·7	3	9·5			32
12	1	2·0	42	84·0	6	12·0	1	2·0	50
13			15	79·0	4	21·0			19
14			5	83·0	1	16·6			6
15			3	100·0					3
19					1	100·0			1
Totals	9	7·2	99	79·2	15	12·0	2	1·6	125

TABLE C.

TABLE C.

Thickness of Nerve VIII.	i.			ii.			iii.			Totals.
	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	
	One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		
3		1	6·2		1	6·2		14	87·5	16
4					4	8·2		45	91·8	49
5								45	100·0	45
6							1	7	100·0	7½
7								5	100·0	5
8							1	2	100·0	2½
Totals		1	·7		5	3·9	2	118	95·4	125

TABLE D.

Thickness of Nerve VIII.	i.			ii.			iii.			iv.			v.			vi.			vii.			viii.			Totals.
	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	
	One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		
3		1	6·2		2	12·5		4	25·0		5	31·2		3	18·0								1	6·2	16
4		2	4·0	1	4	9·1		9	18·3	8	13	34·6	6	11	28·5		1	2·0				1	1	3·0	49
5	1		1·1	1	3	7·7		3	6·6	3	15	36·6		14	31·1	1	1	3·3		1	8·8	2	1	4·4	45
6								3	39·9		1	13·3		2	26·6							1	1	20·0	7½
7										1	1	30·0	1		10·0	1		10·0		1	20·0	1	1	30·0	5
8																						1	2	100·0	2½
Totals	1	3	3·2	2	9	8·0		19	15·2	12	35	32·7	7	30	26·6	2	2	2·3		5	4·0	6	7	8·0	125

TABLE E.

Thickness of Nerve IX.	i			ii			iii.			iv.			v.			vi.			vii.			viii.			Totals.
	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	
	One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		
6								1	50·0								1	50·0							2
7		1	12·5		1	12·5				2	2	37·5	1	2	31·3							1		6·2	8
8		2	5·4	1	1	4·0		7	18·8	5	10	33·7	2	8	24·3					1	2·7		4	10·8	37
9					7	14·0		6	12·0	5	15	35·0	4	11	26·0	1	1	3·0		1	8·0	2		2·0	50
10	1		2·5	1		2·5		4	20·0		6	30·0		6	30·0	1		2·5				3	1	12·5	20
11								1	14·2		2	28·4		2	28·4								2	28·4	7
16														1	100·0										1
Totals	1	3	2·8	2	9	8·0		19	15·2	12	35	32·8	7	30	26·8	2	2	2·4		5	4·0	6	7	8·0	125

TABLE F.*

Thickness of Nerve VIII.	i.			ii.			iii.			iv.			v.			Totals.
	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	
	One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		
3	1		2·7	2	6	37·8		7	37·8		4	21·6				18½
4				2	14	26·7		32	57·1		9	16·0				56
5		2	4·4	1	5	12·3		20	44·0		16	35·2		1	2·2	44½
6				1	1	21·4		2	28·5	1	2	35·7		1	14·2	7
7					1	20·0				1	3	70·0	1		10·0	5
8				1	1	37·5		1	25·0	1	1	37·5				4
Totals	1	2	1·8	7	28	22.5		62	45·9	3	35	27·0	1	2	1·8	135

* It will be noticed that there appear to be discrepancies between the totals of Tables F, G, H, K, etc., and those in Table A. This is due to the fact that one frog, or even one side of one individual, may be represented in two columns, *cpt.* in Table K, form ii., sometimes after sending one or more large branches to nerve X., nerve XI. will pass down and breaking up join branches of nerve X. as in form iii.

TABLE G.

Thickness of Nerve IX.	i.			ii.			iii.			iv.			v.			Totals.
	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	
	One side.	Both sides		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		
6				1	1	50·0				1	1	50·0				3
7					2	22·2		4	44·4		3	33·3				9
8					13	31·7		15	36·5		12	29·3		1	2·4	41
9	1		·9	2	12	24·3		25	46·7		15	28·0				53½
10		2	10·4		1	5·2		13	68·4	2	1	10·4	2		5·2	19
11					1	11·7		5	58·5		2	23·4	1		5·8	8½
16											1	100·0				1
Totals	1	2	1·8	3	30	22·5		62	45·9	3	35	27·0	3	1	1·8	135

TABLE H.

Thickness of Nerve X.	i.			ii.			iii.			iv.			v.			Totals.
	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	
	One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		
12					1	33·3		1	33·3		1	33·3				3
11					1	50·0					1	50·0				2
10		1	5·8	1	3	20·5		7	41·0		5	29·4	1		2·9	17
9		1	3·1	2	10	34·8		13	41·2	1	6	20·6				31½
8	1		1·4	1	6	18·3	1	22	63·3		6	16·9				35½
7				1	7	28·8		9	34·6	1	9	36·5				26
6								4	46·8	1	4	52·9				8½
5								4	56·8		2	28·4		1	14·2	7
4				1		16·6		1	33·3		1	33·3	1		16·6	3
3				1		33·3	1		33·3				1		33·3	1½
Totals	1	2	1·8	7	28	22·5	2	61	45·9	3	35	27·0	3	1	1·8	135

TABLE K.

Thickness of Nerve XI.	i.			ii.			iii.			iv.			v.			Totals.
	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	
	One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		
6								1	100·0							1
5	1		11·1		3	66·6		1	22·2							4½
4		1	9·5	1	4	42·8		2	19·0		3	28·5				10½
3				2	14	26·0		29	50·4		13	22·6	1		·87	57½
2		1	1·7		9	15·3		28	46·2	1	19	32·8	2	1	3.4	59½
1								1	50·0		1	50·0				2
Totals	1	2	1·8	3	30	22·5		62	45·9	1	36	27·0	3	1	1·8	135

TABLE L.

Thickness of Nerve XI.	i.			ii.			iii.			Totals.
	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	
	One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		
6								1	100·0	1
5	1	1	37·5	1		12·5		2	50·0	4
4	1	2	31·2		1	12·5	1	4	56·2	8
3	4	9	18·3	2	6	11·6	4	40	70·0	60
2		7	12·0		2	3·4		49	84·4	58
1								2	100·0	2
Totals	6	19	16·5	3	9	7·8	5	98	74·8	133

TABLE M.

Thickness of Nerve IV.	i.			ii.			iii.			iv.			Totals.
	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	
	One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		
2					1	100·0							1
3	7	1	7·3	10	40	73·7	3	9	17·2		1	1·6	61
4	2	1	3·5	9	34	67·2	5	12	25·4		2	3·5	57
5				5	7	72·2	1	2	19·0		1	7·6	13
6					1	100·0							1
Totals	9	2	4·8	24	83	71·4	9	23	20·6		4	3·0	133

TABLE N.

Thickness of Nerve III.	i.			ii.			iii.			iv.			Totals.
	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	
	One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		
7					1	100·0							1
9					1	50·0		1	50·0				2
10	3		11·1	2	9	74·0	2	1	14·8				13½
11	3	1	7·4	5	23	76·1	1	5	16·4				33½
12	2	1	3·7	5	36	71·2	5	9	21·2		2	3·7	54
13					13	68·2		4	21·0		2	10·5	19
14	1		8·3	4	2	66·6	1	1	25.0				6
15					1	33·3		2	66·6				3
19					1	100·0							1
Totals	9	2	4·8	16	87	71·4	9	23	20·6		4	3·0	133

TABLE O.

Thickness of Nerve III.	i.			ii.			iii.			iv.			v.			Totals.
	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	
	One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		
7														1	100·0	1
9										1	1	75.0	1		25·0	2
10	1		4·5	2		9·0				1		4·5	4	7	81·8	11
11				1		1·5	1		1·5	4	11	40·6	4	16	56·2	32
12										3	11	25·0	3	36	75·0	50
13										1	4	23·6	1	14	76 3	19
14										1	1	25·0	1	4	75 0	6
15														3	100·0	3
19														1	100·0	1
Totals	1		·4	3		1·2	1		·4	11	28	26·8	14	82	71·2	125

TABLE P.

Thickness of Nerve II.	i.			ii.			iii.			iv.			v.			Totals.
	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	No. of Obs.		Per cent.	
	One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides.		One side.	Both sides		
6	1		25·0										1	1	75·0	2
5										1	3	23·3	3	10	76·6	15
4				2		1·0				9	22	26·7	13	65	72·2	99
3				1		5·5	1		5·5	3	2	38·8	1	4	50·0	9
Totals	1		·4	3		1·2	1		·4	13	27	26·8	28	80	71 2	125

ANNUAL REPORT OF THE COUNCIL

FOR THE YEAR 1895.

The Council of the Royal Society herewith presents to the Members of the Society the Annual Report and Balance Sheet for the Year 1895.

The following Meetings were held, and Papers read during the Session :—

March 14.—1. "On the Relation between the Atomic Weights and the Wave-lengths of the Spectrum Lines of the Elementary Bodies," by Ludwig Rummel (communicated by R. L. J. Ellery, F.R.S.) 2. "A Statistical Account of Australian Fungi," by D. McAlpine. 3. "Preliminary Notice of a New Marsupial from Central Australia," by Professor Baldwin Spencer, M.A.

April 9.—1. "Further Preliminary Notice of Certain New Species of Lizards from Central Australia," by A. H. S. Lucas, M.A., B.Sc., and C. Frost, F.L.S. 2. "Notes on Birds Nesting on Albatross Island, Bass Straits," by Dudley Le Souef and H. P. C. Ashworth. 3. "Further Notes on Birds' Nests and Eggs," by A. J. Campbell.

June 13.—1. "Catalogue of Non-Calcareous Sponges," collected by J. Bracebridge Wilson, Esq., M.A., in the neighbourhood of Port Phillip Heads. Part II., by Professor Arthur Dendy, D.Sc. 2. "Observed Variations in the Dip of the Horizon," by T. W. Fowler, M.C.E. 3. "Notes on *Uromyces amygdali*," Cooke (Prune Rust). "A Synonym of *Puccinia pruni*. Pers," by D. McAlpine. 4. "A Puccinia on Groundsel, with Trimorphic Teleutospores," by D. McAlpine. 5. "Australian Fungi," Part II., by D. McAlpine. 6. "Preliminary Description of Certain New Marsupials from Central Australia, together with remarks on the occurrence and identity of *Phascologale cristicauda*," Krefft, by Professor Baldwin Spencer, M.A. 7. "Exhibition of Micro-metric Rulings," by J. Shephard.

August 8.—1. "Preliminary Notice of Certain New Spiders from Central Australia," by H. R. Hogg, M.A. 2. "Oological

Notes," by Dudley Le Souef. 3. "On the Occurrence of a Cambrian Formation in Victoria," by R. Etheridge, Jun. 4. "Exhibition of Anaglyphs," by Professor Kernot, M.A., C.E. 5. "Exhibition of the Spectrum Top," by Dr. J. W. Barrett.

October 10.—1. "Notes on the Tertiary Fossils of Table Cape, Tasmania," by G. B. Pritchard. 2. "Observations with Aneroid and Mercurial Barometers and Boiling Point Thermometers," by T. W. Fowler, M.C.E.

November 14.—1. "A Historical Sketch of the Royal Society of Victoria," by Fredk. A. Campbell, C.E. 2. "Notes on the Custom connected with the Kurdaitcha Shoes of Central Australia," by P. M. Byrne (communicated by Professor Spencer). 3. "Notes on *Didymograptus caduceus*, Salter, with remarks on its Synonymy," by T. S. Hall, M.A.

December 12.—1. "Remarks on the Proposed Subdivision of the Eocene Rocks of Victoria," by T. S. Hall, M.A., and G. B. Pritchard. 2. "Note on a Victorian Host of the Larval Stage of the Liver Fluke," by Thomas Cherry, M.D., M.S. 3. "The Present Position of the Glacial Question," by E. G. Hogg, M.A. (illustrated by Lantern Slides).

During the course of the year two members and three associates have been elected, and eight members and three associates have resigned.

The Librarian reports as follows :—The rate of growth of the Society's Library has been maintained during the year, 1328 new books and parts of periodicals having been received. The crowded condition of the book-shelves having become a serious inconvenience, a Committee was appointed to confer with the Librarian on the matter. The Committee accepted the estimate of Mr. C. Hill for shelving one side of the Council Room at the cost of £10 10s. The work is now done, and the Librarian proposes that in future the room hitherto termed the Library shall be reserved for works published in English, French or German, while those in other languages will be kept in the Council Room, where they will be available for members."

During the year the following publication has been issued :—"Transactions," Vol. IV.—containing a "Monograph of the Tertiary Polyzoa of Victoria," by the late Dr. P. H. MacGillivray. Vol. VIII. of the "Proceedings" is now in the press and will shortly be issued.

The publication of "Transactions," Vol. IV., has practically exhausted the funds at the disposal of the Society for publishing purposes, and it has been with great regret that the Council has been obliged to forego the publication of certain papers presented to it.

The Government Grant has been reduced to £100, and this, together with the smaller amount received from subscriptions, leaves but little money available when the necessary expenses connected with the maintenance of the building and library have been defrayed.

During the past year the Society has lost by death three of its most prominent members—Mr. Cosmo Newbery, Dr. P. H. MacGillivray, Mr. J. Bracebridge Wilson. The first-named, owing to ill-health, had been prevented during recent years from taking any active part in the work of the Society, in which, during earlier years, he was a prominent and active worker. At the time of his death, Dr. MacGillivray was engaged upon the publication of his "Monograph of the Tertiary Polyzoa," which has since been issued in quarto form, illustrated by 22 plates. This work will form a lasting monument to the ability and enthusiastic work on the subject to which Dr. MacGillivray had devoted all his leisure time. Through the generosity of the Government the whole of Dr. MacGillivray's collection and his valuable library of works relating to the Polyzoa have been secured for the colony.

In Mr. J. Bracebridge Wilson the Society has lost one of its most active workers. It has been entirely due to his efforts that a splendid collection has been made of the marine fauna of Port Phillip. Various memoirs, dealing with a portion of this material, have been published by the Society, but it will be many years before the whole material has been dealt with. Mr. Wilson's services have always been placed ungrudgingly at the disposal of the Society, to which he presented the whole of his large and valuable collection, and his loss will be keenly felt.

The Honorary Treasurer in Account with the Royal Society of Victoria.

Dr.				Cr.		
To Balance from 28th February, 1895 ...		£170	0 8	By Printing and Stationery	£264	7 9
Government Grant—				Rates	3	10 0
Balance of Vote, 1894-95		125	0 0	Gas and Fuel	8	12 2
Entrance Fees		4	4 0	Salary, etc., of Assistant Secretary ...	100	0 0
Subscriptions—				Hall-keeper's Allowance	7	10 0
Members ... £67 4 0				Collector's Commission	22	16 3
Country Members 8 18 6				Insurance	4	0 0
Associates ... 27 16 6				Postages	23	1 6
Arrears ... 66 15 0				Repairs	7	2 6
		170	14 0	Books and Periodicals	3	11 0
Rent of Rooms		15	2 6	Freight	7	17 8
Sale of Transactions		11	12 4	Refreshments	1	2 0
Interest		8	0 0	Binding	6	17 3
				Incidentals	6	2 0
				Balance (29th February, 1896) ...	38	3 5
		£504	13 6		£504	13 6

PUBLISHING AND RESEARCH FUND.

Dr.			Cr.		
To Fixed Deposit in Bank	£300 0 0		By Fixed Deposit in Bank of Australasia	£300 0 0	
Interest on same	8 0 0		Interest transferred to General Account	8 0 0	
	£308 0 0			£308 0 0	

Compared with the Vouchers and Bank Pass-book and Cash-book, and found correct,

C. R. BLACKETT,
Hon. Treasurer.

H. MOORS,
JAMES E. GILBERT, } *Auditors.*

29th February, 1896.

REPORTS OF COMMITTEES.

(1) Report of the Port Phillip Biological Committee.

During the year Mr. E. R. Sykes, B.A., has reported on the collection of Polyplacophora which had been got together mainly by the late Mr. J. Bracebridge Wilson. The report with a plate has been published in the "Proceedings of the Malacological Society," vol. II., pt. 2, July, 1896. Mr. Sykes has been able to compare the specimens with those types which are in the British Museum and, in some cases, has had the advantage of the advice of Mr. Pilsbry. He has thus executed a revision which will be of the greatest value to students of our Mollusca, and for which the warmest thanks of the Society are due. The types of the new species and the originals of the figured specimens, together with examples of all the twenty-two species enumerated have been returned to the Society, and are at present in the Museum of the Biological School.

Owing to the scarcity of funds at the disposal of the Society for publication purposes Mr. G. B. Pritchard has suspended his work on the revision of the Mollusca of Victoria. This is greatly to be regretted as he had already completed a portion of the work and has a large amount of material and notes on hand.

Baldwin Spencer, *Secretary.*

(2) Report of the Gravity Survey Committee.

The work of the Committee, consisting of Professors Lyle and Masson, Messrs. Baracchi, Ellery, Love (Secretary), and White, during the past year consists mainly in a determination of the constants of the pendulums. This is now nearly completed, and will be finished very shortly. The reduction of Mr. Love's observations is in great measure completed; and it is hoped that the complete results of the Melbourne observations and of those made in England will be ready for publication early next year.

E. F. J. Love, *Secretary.*

(3) Report of the House Committee.

At the beginning of the present year new shelving was put up in the Council Room, owing to the increase in the number of books in the Library. No other expense has been incurred. The Rooms, Library, etc., have been kept in order and cleanliness, and the building grounds, and fences are in fair condition.

C. R. Blackett, *Convener.*

The Royal Society of Victoria.

LIST OF MEMBERS,

WITH THEIR YEAR OF JOINING.

Patron.

His Excellency Lord Brassey, K.C.B. 1895

Honorary Members.

Agnew, The Hon. Sir J. W., K.C.M.G., M.E.C., M.D., Hobart, Tasmania 1888
Clarke, Colonel Sir Andrew, K.C.M.G., C.B., C.I.E., London (*President*, 1855 *to* 1857) 1854
Forrest, The Hon. Sir J., K.C.M.G., West Australia ... 1888
Hector, Sir James, K.C.M.G., M.D., F.R.S., Wellington, N.Z. 1888
Liversidge, Professor A., F.R.S., LL.D., University, Sydney, N.S.W. 1892
Neumeyer, Professor George, Ph.D., Hamburg, Germany 1857
Russell, H. C., F.R.S., F.R.A.S., Observatory, Sydney, N.S.W. 1888
Scott, Rev. W., M.A., Kurrajong, Heights, N.S.W. ... 1855
Todd, Sir Charles, K.C.M.G., F.R.S., Adelaide, S.A. . . 1856
Verbeek, Dr. R. D. M., Buitenzorg, Batavia, Java ... 1886

Life Members.

Barkly, His Excellency Sir Henry, G.C.M.G., K.C.B., Carlton Club, London (*President*, 1860 *to* 1863) 1857
Bosisto, Joseph, The Laboratory, Bridge-road, Richmond 1857
Butters, J. S., Empire Buildings, Collins-street West .. 1860

Eaton, H F., Yatala, Walsh-street, South Yarra ... 1857
Elliott, T. S., Cahillstone, Coldstream, Gippsland ... 1856
Elliott, Sizar, 20 Porter-street, Prahran, Victoria ... 1856

Fowler, Thomas W., M.C.E., University, Melbourne ... 1877

Gibbons, Sidney W., F.C.S., 31 Gipps-street, East Melb. 1854
Gilbert, J. E., 210 Walsh-street, South Yarra 1872

Howitt, Edward, Rathmines-road, Auburn, Victoria ... 1868

Love, E. F. J., M.A., 213 Victoria Terrace, Royal Park 1888

Nicholas, William, Bambra-road, Caulfield 1864

Rusden, H. K., Ockley, North-road and Cochrane-street, Brighton 1866

Selby, G. W., 99 Queen-street, Melbourne 1881

White, E. J., F.R.A.S., Observatory, Melbourne ... 1868

ORDINARY MEMBERS.

Allan, Alex. C., Sixth Floor, Colonial Mutual Chambers, Collins-street, Melbourne 1867

Bage, William, M.I.C.E., Prell's Buildings, 70 Queen-street, Melbourne 1888
Balfour, Lewis, Iltapa, Princess-st., Kew, Victoria ... 1892
Baracchi, Pietro, F.R.A.S., Observatory, Melbourne ... 1887
Barnes, Benjamin, Queen's Terrace, South Melbourne ... 1866
Barrett, Dr. J. W., 47 Collins-street East, Melbourne ... 1891
Beckx, Gustave, Queen's Place, St. Kilda-road 1880
Blackett, C. R., F.C.S., Thalassa, Ormond Parade, Elwood 1879
Boese, C. H. E., 20 Erin-street, Richmond, Victoria ... 1895

Campbell, F. A., C.E., Working Men's College, Latrobe-street, Melbourne 1879
Candler, Samuel Curtis, Melbourne Club, Melbourne ... 1888
Cherry, T., M.D., University, Melbourne 1893
Cohen, Joseph B., A.R.I.B.A., Public Works Department, Melbourne 1877

Danks, John, 391 Bourke-street West, Melbourne ... 1871
Dennant, John, F.G.S., F.C.S., Russell-street, Camberwell 1886
Dunn, E. J., F.G.S., 77 Packington-street, Kew, Victoria 1893

Edwards, Thomas Elford, Bourke-road, Balwyn, Victoria 1896
Ellery, R. L. J., C.M.G., F.R.S., F.R.A.S., (*President*, 1866 *to* 1885), Observatory, Melbourne 1856

Fox, W., Westbourne Terrace, Grey-street, St. Kilda ... 1887
Fryett, A. G., Cambridge, Ho. College Park, Lewisham, London 1893

Goldstein, J. R. Y., Office of Titles, Melbourne ... 1879
Gotch, J. S., 109 Albert-street, East Melbourne ... 1881

Hake, C. N., F.C.S., Melbourne Club, Melbourne ... 1890
Hall, T. S., M.A., University, Melbourne 1890
Heffernan, E. B., M.D., 10 Brunswick-street, Fitzroy ... 1879
Hogg, H. R., M.A., 16 Market Buildings, Flinders-lane 1890
Hogg, E. G., M.A., Trinity College, University, Melbourne 1894
Howitt, A. W., F.G.S., Finch-street, South Malvern ... 1877

James, E. M., M.R.C.S., c/o The Hon. Sir William Zeal, 5 St. James' Buildings, William-street 1883
Jamieson, James, M.D., 56 Collins-street East, Melbourne 1877
Joseph, R. E., 644 High-street, Armadale, Victoria ... 1877

Kernot, Professor W C., M.A., C.E. (*President*, 1885 *to* 1896), University, Melbourne 1870

Lyle, Professor T. R., M.A., University, Melbourne ... 1889

McCoy, Professor Sir F., K.C.M.G., D.Sc., F.R.S. (*President*, 1864), University, Melbourne 1855
McAlpine, Daniel, Ardeer, 22 Armadale-street, Armadale, Victoria 1889
Main, Thomas, City Surveyor's Office, Melbourne ... 1881
Masson, Professor Orme, M.A., D.Sc., University, Melbourne 1887
Mathew, Rev. John, M.A., B.D., Coburg, Victoria ... 1890
Moerlin, C., Eden Park, New and Dendy streets, Middle Brighton 1872
Moors, H., 498 Punt-road, South Yarra 1857
Muntz, T. B., C.E., Prell's Buildings, Queen-street, Melbourne 1873

Nanson, Professor E. T., M.A., University, Melbourne ... 1875
Nimmo, W. H., Melbourne Club, Melbourne 1888

Officer, C. G. W., B.Sc., Clendon-road Toorak; 434 Collins-street, Melbourne 1890
Oldfield, Lenthal, 36 Nicholson-street, Fitzroy, Victoria 1890

Rosales, Henry, F.G.S., Alto Mira, Grandview Grove, Armadale 1880
Rule, O. R., 4 Station-street, Canterbury, Victoria ... 1882

Sargood, Sir Frederick, K.C.M.G., M.L.C., Elsternwick 1883
Spencer, Professor W. Baldwin, M.A., University, Melb. 1887
Sugden, Rev. E. H., B.A., B.Sc., Queen's College, Carlton, Victoria 1889

Sweet, George, F.G.S., Wilson-street, Brunswick, Victoria 1887

Tisdall, H. T., 7 Washington-street, Toorak, Victoria ... 1883
Topp, C. A., M.A., LL.B., F.L.S., Observatory Ho., South Yarra 1887

Wilkinson, W. Percy, College of Pharmacy, Melbourne ... 1894

Country Members.

Barber, Rev. H. Bride, Parsonage, Beaufort, Victoria ... 1895

Cameron, John, Orbost, Victoria 1888
Clark, Donald, School of Mines, Bairnsdale, Victoria ... 1892
Conroy, Jas. McDowall, Wingham, Manning River, N.S.W. 1877

Dawson, J., Scott-street, Camperdown, Victoria ... 1891
Dobson, A. Dudley, M.I.C.E., F.G.S., Warrnambool, Victoria 1891

Eastick, J., Millaquin Sugar Refinery, Bundaberg, Queensland 1893

Fardy, F. J., California Gully, Bendigo 1894
Fennelly, Richard, A.M.I.C.E., Kilmore, Victoria ... 1895
Field, William Graham, Railway Department, Melb. ... 1880
Foord, George, Boundary-road, Burwood, Victoria ... 1894

Ivey, James, Ballarat, Victoria 1888

Keogh, Lawrence F., Heytesbury Park, Camperdown ... 1872

Loughrey, B., M.A., C.E., 3 Elgin-street, Hawthorn ... 1880

Manson, Donald, Elgin Buildings, Sydney 1889
Murray, Stuart, C.E., Department of Mines, Melb. ... 1874

Oddie, James, Dana-street, Ballarat, Victoria 1882
Officer, Sidney, c/o Mrs. Officer, Ottawa, Toorak ... 1890
Oliver, C. E., C.E., Metropolitan Board of Works, Melb. 1879

Powell, Walter D. T., Cape Moreton Light House, Brisbane, Queensland 1886
Purdie, A., M.A., School of Mines, Bendigo, Victoria ... 1892

Shaw, W. H., Phœnix Foundry, Ballarat 1888

Tipping, Isaac, 75 Lyons-street, Ballarat, Victoria ... 1892

Williams, Rev. W., F.L.S., Wesleyan Parsonage, North Melbourne 1885

Corresponding Members.

Bailey, F. M., The Museum, Brisbane, Queensland ... 1880

Dendy, Professor Arthur, D.Sc., F.L.S., Canterbury College, Christchurch, N.Z. 1894

Etheridge, Robert, Junr., Australian Museum, Sydney, N.S.W. 1877

Lucas, A. H. S., M.A., B.Sc., F.L.S., Newington College, Sydney, N.S.W. 1895

Stirton, James, M.D., F.L.S., 15 Newton-street, Glasgow 1880

Ulrich, Professor G. H. F., F.G.S., Dunedin, Otago, N.Z. 1857

Wagner, William, LL.D., Philadelphia, U.S.A. ... 1884

Associates.

Atkinson, John A., 2 Mary-street, Windsor 1894
Avery, D., M.Sc., Queen's College, Carlton, Victoria ... 1893

Baker, Thomas, Bond-street, Abbotsford, Victoria ... 1889
Bale, W. M., Walpole-street, Hyde Park, Kew, Victoria 1887
Barnard, Robert J. A., M.A., Queen's College, Carlton, Victoria 1892
Bennetts, W. R., 184 Brunswick-street, Fitzroy, Victoria 1894
Bevan, Rev. L. D., D.D., LL.B., Congregational Hall, Russell-street 1889
Booth, John, M.C.E., Rennie-street, Coburg, Victoria ... 1882

Campbell, A. J., Elm Grove, Armadale, Victoria ... 1894
Chase, L. H., Leslie-street, Moonee Ponds, Victoria ... 1885
Cresswell, Rev. A. W., M.A., St. Jude's Parsonage, Camberwell, Victoria 1887

Danks, A. T., 391 Bourke-street West, Melbourne ... 1883

Ferguson, W. H., 23 Service Crescent, Albert Park, Victoria 1894

Finney, W. H., Bridport-street, South Melbourne ... 1881
Fison, Rev. Lorimer, M.A., Essendon, Victoria ... 1889

Gabriel, J., Simpson's-road, Abbotsford, Victoria ... 1887
Green, W. Heber, Albany Crescent, Surrey Hills, Victoria 1896

Hart, T. S., M.A., Wilson-street, Brighton, Victoria ... 1894
Harvey, J. H., 127 Gipps-street, East Melbourne ... 1895
Hill, W. H. F., Glenrowan, Dandenong-road, Windsor ... 1894
Holmes, W. A., Telegraph Engineer's Office, Railway Department, Melbourne 1879
Hubbard, J. R., Perth, West Australia 1884

Ingamells, F. N., c/o Ronalds, Florist, Swanston-st., Melb. 1889

Jutson, J. T., 16 Roseneath-street, Clifton Hill, Victoria 1895

Kernot, Frederick A., Royal Park, Melbourne ... 1881
Kitson, A. E., 372 Albert-street, East Melbourne ... 1894

Lambert, Thomas, Bank of New South Wales, Collins-street, Melbourne 1890
Le Souëf, Dudley, Zoological Gardens, Royal Park ... 1894
Lidgey, E. A., Department of Mines, Melbourne ... 1894
Luby, W. H., Department of Mines, Treasury, Melbourne 1896

Maclean, C. W., 276 Walsh-street, South Yarra ... 1879
Melville, A. G., Mullen's Library, Collins-street East, Melbourne 1889

Phillips, A. E., c/o Mr. Gordon, 372 Little Flinders-street West, Melbourne 1883
Pritchard, G. B., Mantell-street, Moonee Ponds, Victoria 1892

Quarry, Herbert, G.P.O., Melbourne 1880

Robertson, E. J., 411 Toorak-road, South Yarra, Victoria 1895
Robinson, C. A., Lands Department, Treasury, Melbourne 1894
Rosenhain, Walter, B.A., Williams-road, South Yarra ... 1896

Schafer, R., Union-street, Windsor, Victoria 1883
Shaw, Alfred C., Bond-street, Abbotsford, Victoria ... 1896
Shephard, John, 135 City-road, South Melbourne ... 1894
Steele, W. H., M.A., Sherwood-street, Richmond, Victoria 1892
Stewart, C., Third Floor, Oxford Chambers, Bourke-street, Melbourne 1883

Strettle, W. S., B.C.E., Public Works Department, Perth, W.A. 1891

Tate, Frank, M.A., Station-street, Box Hill 1889

Wallace, W. Mines Department, Treasury, Melboure ... 1896
Wedeles, James, 231 Flinders-lane, Melbourne ... 1896

LIST OF THE INSTITUTIONS AND LEARNED SOCIETIES THAT RECEIVE COPIES OF THE "TRANSACTIONS" AND "PROCEEDINGS" OF THE ROYAL SOCIETY OF VICTORIA.

England.

Agent-General of Victoria	London
Anthropological Institute	London
Balfour Library	Cambridge
Biological Society of Liverpool	Liverpool
Bodleian Library	Oxford
British Museum	London
Colonial Office Library	London
"Electrician"	London
Foreign Office Library	London
Free Public Library	Liverpool
Geological Society	London
Institute of Mining and Mechanical Engineers ...	Newcastle
Institution of Civil Engineers	London
Linnæan Society	London
Literary and Philosophical Society	Liverpool
Literary and Philosophical Society ...	Manchester
Manchester Museum, Owens College	Manchester
Marine Biological Laboratory	Plymouth
Natural History Museum	London
Naturalists' Society	Bristol
"Nature"	London
"Natural Science"	London
Owens College Library	Manchester
Patent Office, 25 Southampton Buildings	London
Philosophical Society	Cambridge
Physical Society	London
Radcliffe Library	Oxford
Royal Asiatic Society	London
Royal Astronomical Society	London
Royal College of Science	South Kensington
Royal Colonial Institute	London
Royal Gardens	Kew
Royal Geographical Society	London
Royal Microscopical Society	London

Royal Society	London
Statistical Society	London
University College	London
University Library	Cambridge
Yorkshire College	Leeds

Scotland.

Botanical Society	Edinburgh
Geological Society	Edinburgh
Royal College of Physicians' Laboratory	Edinburgh
Royal Observatory	Edinburgh
Royal Physical Society	Edinburgh
Royal Society	Edinburgh
Royal Scottish Society of Arts	Edinburgh
Scottish Geographical Society	Edinburgh
University Library	Edinburgh
University Library	Glasgow
Philosophical Society	Glasgow

Ireland.

Natural History and Philosophical Society ...	Belfast
Royal Dublin Society	Dublin
Royal Geological Society	Dublin
Royal Irish Academy	Dublin
Trinity College Library	Dublin

Germany.

Gesellschaft für Erdkunde	Berlin
Grossh. Hessische Geologische Anstalt	Darmstadt
Jenaische Zeitsch. f. Medicin und Naturwissenschaft	Jena
Königl. Botanische Gesellschaft	Regensburg
Königl. Öffentl. Bibliothek	Dresden
Königl. Preussische Akademie der Wissenschaften ...	Berlin
Königl. Sachs. Gesellschaft der Wissenschaften ...	Leipzig
Königl. Societät der Wissenschaften	Göttingen
Naturforschende Gesellschaft	Emden
Naturforschende Gesellschaft	Halle
Naturforschende Gesellschaft	Leipzig
Naturforschende Gesellschaft Bleichstrasse 59.	Frankfurt am M.
Naturhistorisch Medizinischer Verein	Heidelberg
Naturhistorisches Museum	Hamburg
Naturhistorisches Museum	Hanover
Naturwissenschaftlicher Verein	Bremen
Oberhessische Gesellschaft für Natur & Heilkunde ...	Giessen

Schlesische Gesellschaft für vaterländ. Cultur ...	Breslau
Verein für Erdkunde	Darmstadt
Verein für Erdkunde	Halle
Verein für Naturkunde	Kassel

Austro-Hungary.

Imperial Observatory	Prague
K. K. Akademie der Wissenschaften	Vienna
K. K. Geologische Reichsanstalt	Vienna
K. K. Geographische Gesellschaft	Vienna
K. K. Naturhistorisches Hofmuseum	Vienna
K. K. Zoologische Botanische Gesellschaft ...	Vienna

Switzerland.

Geographische Gesellschaft	Berne
Geogr. Commerc. Gesellschaft	St. Gallen
Geogr. Commerc. Gesellschaft	Aarau
Naturforschende Gesellschaft	Zurich
Schweizerische Naturforschende Gesellschaft ...	Berne
Société de Physique et d'Histoire Naturelle ...	Genéve

France.

Académie des Sciences, Belles Lettres et Arts ...	Lyon
Annuaire Geologique Universel	Paris
Bibliothéque et Faculté des Sciences	Marseilles
Feuilles des Jeunes Naturalistes	Paris
Société Académique Indo-Chinoise	Paris
Société de Geographie	Paris
Société d'Etudes Scientifiques	Paris
Société Nationale de Cherbourg	Cherbourg
Société Zoologique de France	Paris
Société des Sciences Naturelles de l'Ouest de la France (Museum)	Nantes

Italy.

Biblioteca Nazionale Centrale Vittorio Emanuele ...	Rome
British and American Archæological Society ...	Rome
Museo di Zoologia ed Anatomia Comp., R. Università	Turin
Ministerio dei Lavori Pubblici	Rome
R. Accademia delle Scienze dell' Instituto ...	Bologna
Reale Accademia di Scienze	Palermo
Reale Accademia di Scienze, Lettere ed Arti ...	Lucca
Regia Accademia di Scienze, Lettere ed Arti ...	Modena
Società Geografica Italiana	Rome
Società Toscana di Scienze Naturali	Pisa
Zoological Station	Naples

Spain and Portugal.

Real Academía de Ciencias exactas, físicas y naturales	Madrid
Sociedade de Geographia	Lisbon

Holland and Belgium.

Académie Royale de Belgique	Bruxelles
Bataviaasch Genootschap van Kunsten en Wetenschappen	Batavia
Musée Teyler	Haarlem
Magnetical and Meteorological Observatory ...	Batavia
Natuurkundig Genootschap	Groningen
Nederlandisch Botan. Vereiniging	Nijmegen
Kon. Akademie van Wetenschappen	Amsterdam
Sociètè Hollandaise des Sciences	Haarlem
Sociètè Malacologique Royale de Belgique ...	Bruxelles
Société Provinciale des Arts et Sciences	Utrecht

Denmark, Sweden, and Norway.

Académie Royale	...Copenhagen
Entomologiska Föreningen	... Stockholm
Videnskabs-Selskabet	... Christiania
Royal University Library	Upsala
Kongl. Vetenskaps Akademien	... Stockholm

Russia and Roumania.

Institut Météorologique de Roumanie	Bucharest
Jardin Botanique Imperial	St. Petersburg
Minister of Agriculture, St. Petersburg, c/o Russian Consulate	Melbourne
Russian Geographical Society, Priamom Branch, Ishita	Siberia
Société des Naturalistes de l'Université de Kasan ...	Kasan
Société des Naturalistes Kiew	Kiew
Société des Naturalistes de la Nouvelle Russie ...	Odessa
Société Impériale des Naturalistes	Moscow
Sociètè Impériale Russe de Geographie ...	St. Petersburg
Magyar Kiralyi Természettudomanyi Tarsulat ...	Budapest

Cape of Good Hope.

South African Philosophical Society, Observatory ...	Cape Town

India.

Geological Survey of India	Calcutta
Madras Literary Society	Madras
Natural History Society	Bombay
Royal Bengal Asiatic Society	Calcutta
Royal Asiatic Society, Ceylon Branch	Colombo

Mauritius.

Meteorological Society	Mauritius

China and Japan.

Astronomical Observatory	...Hong Kong
China Branch of the Royal Asiatic Society	... Shanghai
Imperial University	Tokio
Seismological Society of Japan	Tokio

Canada.

Canadian Institute	Toronto
Geological and Natural History Survey of Canada ...	Ottawa
Minister's Office (Militia and Defence)	Ottawa
Royal Society of Canada	Montreal

United States.

Academy of Natural Sciences	... Davenport
Academy of Natural Sciences	Philadelphia
Academy of Sciences	San Francisco
American Museum of Natural History, Central Park	New York
American Academy of Arts and Sciences	... Boston
American Geographical Society	... New York
American Philosophical Society	Philadelphia
Astor Library	... New York
Bureau of Ethnology, Smithsonian Institute	Washington
Colorado Scientific Society	... Denver
Cooper Union for the Advancement of Science & Art	New York
Denison University	Ohio
John Hopkins University	. . Baltimore
Maryland Historical Society	... Baltimore
Natural Academy of Sciences	Washington
Office of Chief of Engineers, U.S. Army ...	Washington
Philosophical Society	Washington
"Science"	... New York
Smithsonian Institution	Washington
Society of Natural History	... Boston
Society of Natural Sciences	... Buffalo
Texas Academy of Sciences	... Austin

United States Geological Survey ... Washington
University of California, Berkly ... San Francisco
Wisconsin Academy of Sciences, Arts, and Letters ... Madison

Mexico.

Ministerio de Fomento ... ... Mexico
Observatorio Meteorologico, Magnetico Central ... Mexico
Observatorio Astronomico National ... ... Tatubaya
Sociedad Científica, "Antonio Alzate" ... ... Mexico
Sociedad de Ingeniecos de Ialisco ... Guadalajara
Secretaria de Fomento ... ... Guatemala

Argentine Republic.

Academía Nacional de Ciencias Exactas ... ... Cordoba
Direccion General de Estadistica ... Buenos Ayres
La Museo di Plata ... ... Buenos Ayres

Australasia.—Victoria.

"Age" ... ... Melbourne
"Argus" ... ... Melbourne
Athenæum ... ... Melbourne
Astronomical Observatory ... ... Melbourne
Chief Secretary's Office ... ... Melbourne
Department of Mines and Water Supply ... ... Melbourne
Field Naturalists' Club of Victoria ... ... Melbourne
Free Library ... ... Echuca
Free Library ... ... Geelong
Free Library ... ... Bendigo
Geological Society of Australasia ... ... Melbourne
Gordon Technical College ... . Geelong
Government Entomologist ... ... Melbourne
Government Statist ... ... Melbourne
Medical Society .. .. Melbourne
Parliamentary Library ... ... Melbourne
Pharmaceutical Society of Australasia ... ... Melbourne
Public Library ... ... Melbourne
Railway Library ... ... Melbourne
Royal Geographical Society ... ... Melbourne
Royal Mint ... ... Melbourne
School of Mines ... ... Ballarat
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